The New Brunswick
Electric Power Commission

ENVIRONMENTAL RADIATION
MONITORING DATA
FOR
POINT LEPREAU GENERATING STATION
January 01, 1986 to December 31, 1986

Health Physics Department

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Health Physics Department
Report HP-07000-87-1

February, 1987

EXECUTIVE SUMMARY.

This report, issued annually, is a compilation of the 1986 Environmental Radiation Monitoring Program data collected around the Point Lepreau Generating Station (PLGS) and at reference locations remote from PLGS.

In 1986 over 2000 analyses were made on 1300 samples to monitor environmental radiation in the vicinity of Point Lepreau.

The only measurable radiation dose from PLGS on the local population to the present time, is that from tritiated water vapour in air, calculated to be about 0.6 microsievert per annum at the exclusion zone boundary. Natural radiation in the area contributes more than 2000 times this level.

Fallout radionuclides from the accident at Chernobyl were detected in most sample types collected in May and June in this province. The dose resulting from this was negligible. Details are given in Appendix 1.

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ENVIRONMENTAL REPORTS OF PREVIOUS YEARS

PRE-OPERATIONAL (1975 - 1982)

1 Pre-Operational Radiological Environmental Monitoring Program for Point Lepreau Nuclear Generating Station. NBEPC-HP-75-1. J.A. Flanigan. 1975.

2 Pre-Operational Environmental Radiation Monitoring Data for Point Lepreau Generating Station. October 1, 1976 to June 30, 1979. NBEPC-HP-79-1. J.A. Flanigan and J.J. Paciga. Sept. 1979.

3 Pre-Operational Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 1, 1979 to December 31, 1979. NBEPC-HP-80-1. J.A. Flanigan. Sept. 1980.

4 Pre-Operational Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 1, 1980 to December 31, 1980. NBEPC-HP-81-1. J.K. Sutherland and J.A. Flanigan. July 1981.

5 Pre-Operational Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 1, 1981 to December 31, 1981. NBEPC-HP-82-1. J.K. Sutherland. February 1982.

OPERATIONAL (1982 - 1985)

6 Operational Environmental Radiation Monitoring Program. Revision 1, January 1982. RD-01364-L15. J.K. Sutherland.
Revision 2, June 1983.
Revision 3, September 1985.

7 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1982 to December 31, 1982. HP-07000-83-1. J.K. Sutherland. March 1983.

8 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1983 to December 31, 1983. HP-07000-84-1. J.K. Sutherland. February 1984.

9 Environmental Radiation Monitoring Data for
Point Lepreau Generating Station.
January 01, 1984 to December 31, 1984.
HP-07000-85-1. J.K. Sutherland. February 1985.

10 Environmental Radiation Monitoring Data for
Point Lepreau Generating Station.
January 01, 1985 to December 31, 1985.
HP-07000-86-1. J.K. Sutherland. March 1986.

1.0 INTRODUCTION

The Environmental Radiation Monitoring Program for PLGS, fulfils several objectives. These are:

1. To define the background levels of radiation in the area, whether naturally occurring or from weapons testing fallout.

2. To provide an early indication of the appearance of any radioactive material in the environment caused by the operation of PLGS.

3. To verify the adequacy and proper functioning of Station effluent controls and monitoring systems.

4. To provide an estimate of actual radiation exposure to the surrounding population from the operation of PLGS based upon the analyses of environmental samples.

5. To provide assurance to regulatory agencies and the public that the station's environmental impact is known and within anticipated limits.

In addition, the program has the capability to monitor radionuclides from other sources, as for example from fallout after a Chinese bomb test in 1980, or most recently, from the reactor accident at Chernobyl in the USSR in April of 1986.

The Point Lepreau Generating Station was declared in Commercial Operation on January 31st 1983. The Gross Capacity Factors, indicating the level of operation over the last four years, are tabulated below:

TABLE 1.1

PLGS PRODUCTION PERFORMANCE

	1983 %	1984 %	1985 %	1986 %
Gross Capacity Factor	85.7	89.7	97.4	94.0

Even though power generation was maintained at a high production level in 1986, radionuclide emissions have remained well below target levels of 1% of the combined Derived Emission Limits (DELs) in the liquid and gaseous effluent pathways.

The data contained in this report were collected over the period from January 1st 1986 to December 31st 1986. During this time, the major sample types analyzed and their frequency of collection were as indicated in Table 1.2.
As emissions from PLGS have been at less than 1% of the Derived Emission Limits (DELs) since startup, the frequency of collection is at Level 1, as shown in column 2 (<1% DEL) of this table.

All analyses (approximately 2000 measurements) were performed in the Health Physics Environmental Laboratory at 420 York Street, Fredericton, N.B.

The report is divided into various sections as described below for ease of reference.

Section 2.0 indicates the locations in the Point Lepreau area from which most samples are collected or other measurements are taken.

Section 3.0 describes the statistical approach, the analytical techniques and sample collection and preparation.

Section 4.0 comprises the summary tables of the data collected in 1986, and also provides historical data on some of the samples since 1976.

Section 5.0 is a brief descriptive summary of the major details of the data in section 4.0.

Section 6.0 tabulates the data on the source emissions from PLGS in the airborne and liquid effluent pathways, since 1983.

Section 7.0 summarizes the meteorological data collected around PLGS for 1986. Long term meteorological data for both Saint John and Fredericton are presented to indicate weather patterns for this region.

Quality Assurance (QA) intercomparison data for 1986 (Section 8.0) indicate the level of competence of the laboratory to make the various determinations.

Appendix 1 includes the data collected within New Brunswick concerning the detection of fallout radionuclides from the Chernobyl accident.

In 1986, the only environmental samples which contained detectable radionuclides emitted from PLGS were:

1. Airborne water vapour samples.

2. Parshall Flume and Borehole waters from the Solid Radioactive Waste Management Facility (SRWMF) on the PLGS site.

3. Lagoon waters and lagoon sludge from the PLGS site.

Outside the 1 km boundary, the activity levels of tritium in airborne water vapour samples range from less than 0.1 Bq/m^3 (i.e., not detected) up to 3 Bq/m^3. Since the general public DAC(*) for tritium in air is about 1E4 Bq/m^3, the activity levels of tritium in the environment from the operation of PLGS continue to be insignificant.

* The DAC (Derived Air Concentration) for each radionuclide is the calculated activity in each cubic metre of air that, if maintained for one year, will expose a member of the Critical Group (i.e., the most exposed members of the public) to the Dose Limits for the general public.

TABLE 1.2

SCHEDULE OF SAMPLE COLLECTION AND ANALYSIS

SAMPLE TYPE OR SURVEY	LEVEL 1 FREQUENCY <1% DEL (1)	LEVEL 2 FREQUENCY 1-10% DEL	LEVEL 3 FREQUENCY >10% DEL
Air Particulate (2)	Bi-weekly	Weekly	Weekly
Air Iodine (2)	Bi-weekly	Weekly	Weekly
Air Tritium (2)	Monthly	Weekly	Weekly
TLD (2)	Quarterly	Monthly	Monthly
Sediment	Quarterly	Monthly	Monthly
Beach Survey	Quarterly	Monthly	Weekly
Ground Water (Well, Surface)	Semi-annually	Quarterly	Monthly
Sea Water	Quarterly	Monthly	Monthly
Milk	Quarterly (3) Monthly (4)	Monthly	Monthly
Seafood (Clams, Scallops, Dulse, Crabs, Lobster, Fish, Periwinkles)	Semi-annually	Monthly	Weekly
	---------- As available ----------		

(1) DEL means Derived Emission Limit.
(2) Integrated sample.
(3) Quarterly from selected dairy herds in southern N.B.
(4) Commercial dairy milk sample.

The numbers of environmental samples processed in each category over the last seven years are as shown below:

TABLE 1.3

SAMPLE INFORMATION

Sample Type	Number of Samples Analyzed. Year						
	1980	1981	1982	1983	1984	1985	1986
AC Air C-14	--	--	2	11	13	28	24
AI Air Iodine	56	55	260	363	208	208	208
AP Air Particulate	55	55	260	363	208	207	208
AT Air Tritium	56	52	72	94	101	104	104
BH Borehole Water	--	3	10	30	24	18	12
CL Clams	10	9	6	7	12	13	11
CR Crabs	--	--	--	--	1	2	1
DU Dulse	2	1	1	7	7	9	8
FI Fish	4	9	21	14	16	13	14
LO Lobster	4	3	5	5	7	8	7
LS Lagoon Sludge	--	--	--	2	--	--	11
LW Lagoon Water	--	--	--	2	22	33	38
MI Milk	15	62	19	20	19	20	28
PE Periwinkles	--	--	--	--	3	4	5
PF Parshall Flume	--	--	10	44	47	67	57
QA Quality Assurance	33	21	21	21	24	30	33
SC Scallops	--	--	--	3	7	8	6
SE Sediment	40	40	40	40	41	41	45
SO Soil	--	--	2	--	--	4	--
SP Sea Plant	--	--	--	--	4	8	13
SW Sea Water	16	16	16	17	18	17	18
VG Vegetation (Lichen)	--	4	2	13	13	13	33
WW Well Water	18	18	18	18	18	18	20
ZZ Miscellaneous	1	--	6	6	11	77	100
TLD	87	112	95	115	120	119	131
BS Beach Surveys	33	39	40	40	40	40	40

The miscellaneous samples include those samples which do not readily fit into any of the above categories or are not routinely collected. These include the additional air monitoring samples, leaves of labrador tea, blueberry leaves, blueberries, spruce needles, swamp water, rain water, and samples relating to the operation of PLGS.

Other programs in place to monitor environmental samples from the Point Lepreau area are conducted by:

1. The Department of Health in New Brunswick.

2. The Bedford Institute of Oceanography (BIO), in Dartmouth, Nova Scotia.

3. The Federal Department of Health and Welfare in Ottawa.

Analytical results reported by the various agencies are generally comparable.

2.0 SAMPLE LOCATIONS

The major sample locations are shown in Figures 2.1 to 2.5. Each 'Indicator' station has a three or four-character identification code (e.g., F01, I00A). An indicator station is one within the possible influence of PLGS emissions. 'Reference' locations, chosen to lie outside the influence of PLGS operations, are identified by the letter R at the end of the location code (e.g., A01R). All of these Reference locations fall outside of the map areas.

Sampling locations for mobile seafood species (lobster, fish, etc.) caught in the Point Lepreau area are generally not specified except for the 'Jonah' crabs which are caught near the PLGS cooling water outflow. With the exception of Reference location samples, all seafood samples analyzed are either purchased from local fishermen who made their catch in the Point Lepreau area or are collected by laboratory staff. Reference samples are purchased from fishermen or suppliers who fish outside of the Bay of Fundy region, for example from the Baie de Chaleur or the Northumberland Strait area.

There are no commercial dairy herds in the Point Lepreau area. The nearest dairy herds occur approximately 40 to 50 km away and are therefore not indicated on the maps. Milk samples are routinely collected and analyzed from these locations.

On-site samples from the Solid Radioactive Waste Management Facility (SRWMF), are analyzed on a regular basis. These include Parshall Flume waters, Bore Hole waters and, where available, Cell Drainage water samples. One of the air monitoring stations is also located at this facility.

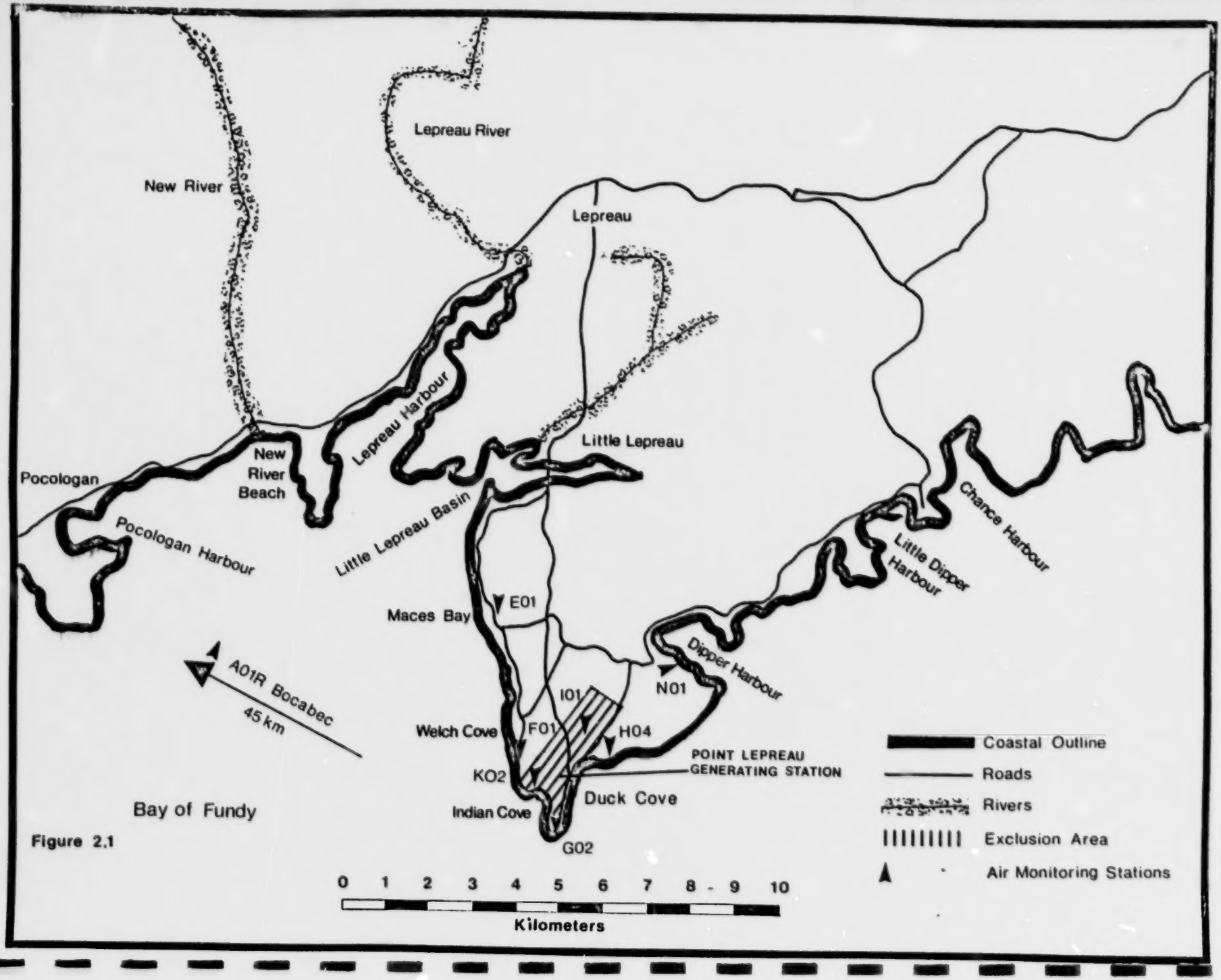
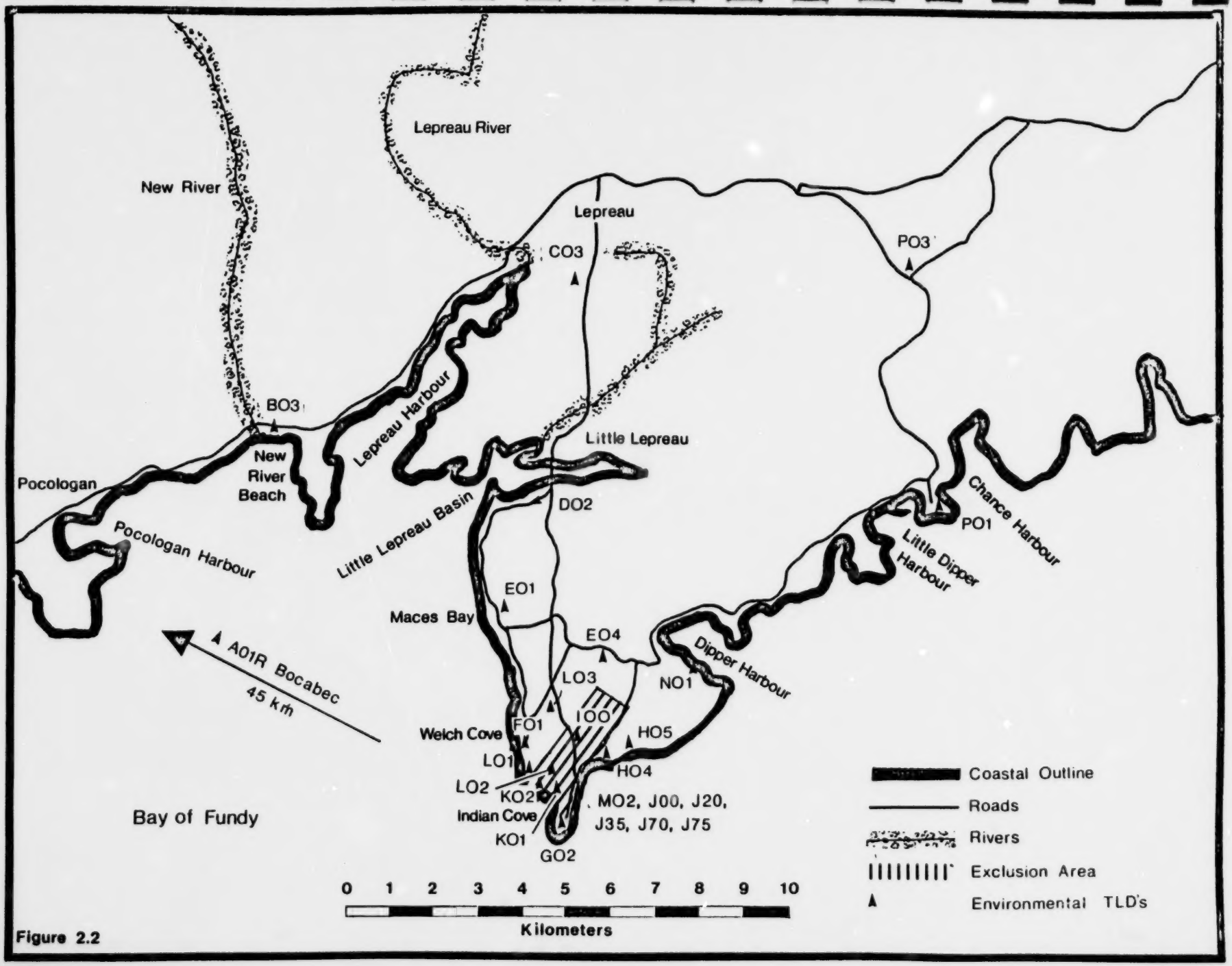

Lepreau River
New River
Lepreau
Lepreau Harbour
Little Lepreau
New River Beach
Pocologan
Pocologan Harbour
Little Lepreau Basin
Chance Harbour
Little Dipper Harbour
Maces Bay
E01
Dipper Harbour
N01
A01R Bocabec
45 km
I01
Welch Cove
F01
H04
POINT LEPREAU GENERATING STATION
KO2
Duck Cove
Indian Cove
G02
Bay of Fundy
0 1 2 3 4 5 6 7 8 - 9 10
Kilometers
Coastal Outline
Roads
Rivers
Exclusion Area
Air Monitoring Stations

Figure 2.1


Lepreau River
New River
Lepreau
CO3
PO3
BO3
New River Beach
Lepreau Harbour
Little Lepreau
Pocologan
Pocologan Harbour
Little Lepreau Basin
DO2
Chance Harbour
PO1
Little Dipper Harbour
EO1
Maces Bay
EO4
Dipper Harbour
NO1
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45 km
Welch Cove
FO1
HO5
LO1
HO4
LO2
KO2
MO2, J00, J20, J35, J70, J75
Indian Cove
KO1
GO2
Bay of Fundy
0 1 2 3 4 5 6 7 8 9 10
Kilometers
Coastal Outline
Roads
Rivers
Exclusion Area
Environmental TLD's

Figure 2.2

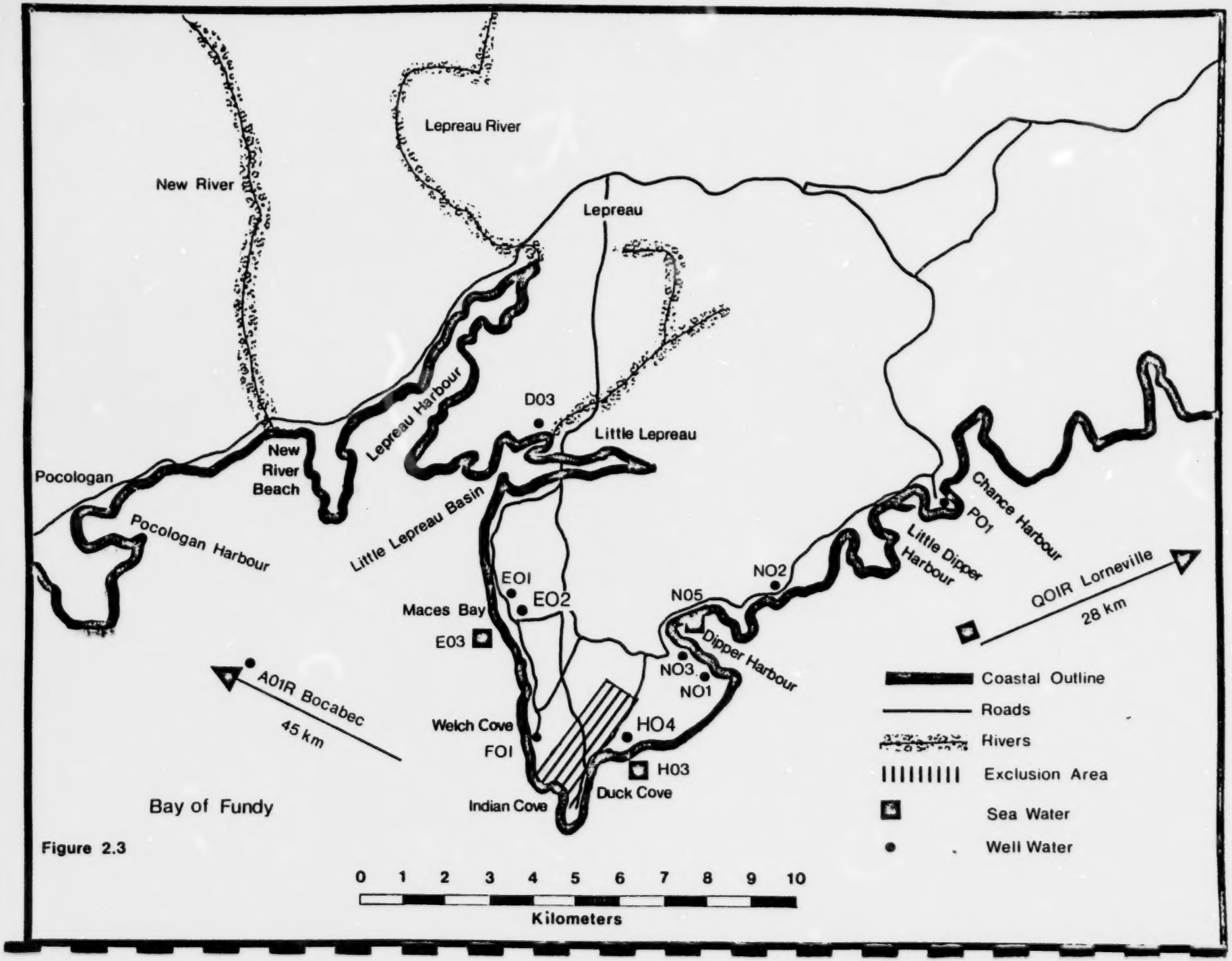
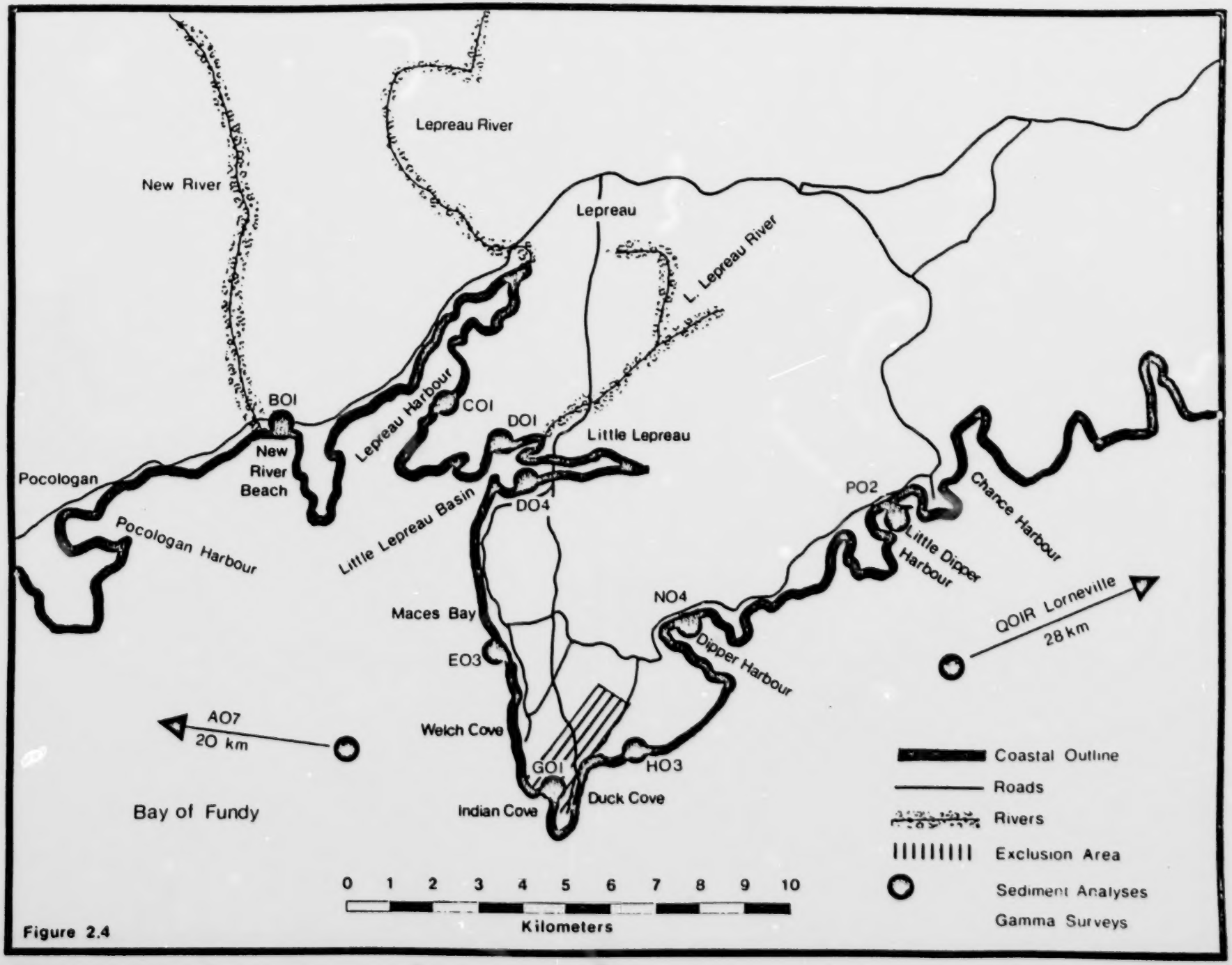

Lepreau River
New River
Lepreau
Lepreau Harbour
D03
Little Lepreau
New River Beach
Pocologan
Pocologan Harbour
Little Lepreau Basin
Chance Harbour
PO1
Little Dipper Harbour
NO2
EO1
EO2
N05
Maces Bay
E03
QOIR Lorneville
28 km
Dipper Harbour
NO3
NO1
A01R Bocabec
45 km
Welch Cove
FO1
HO4
H03
Duck Cove
Indian Cove
Bay of Fundy
Coastal Outline
Roads
Rivers
Exclusion Area
Sea Water
Well Water
0 1 2 3 4 5 6 7 8 9 10
Kilometers

Figure 2.3


Lepreau River
New River
Lepreau
L. Lepreau River
BOI
COI
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Maces Bay
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QOIR Lorneville
28 km
EO3
AO7
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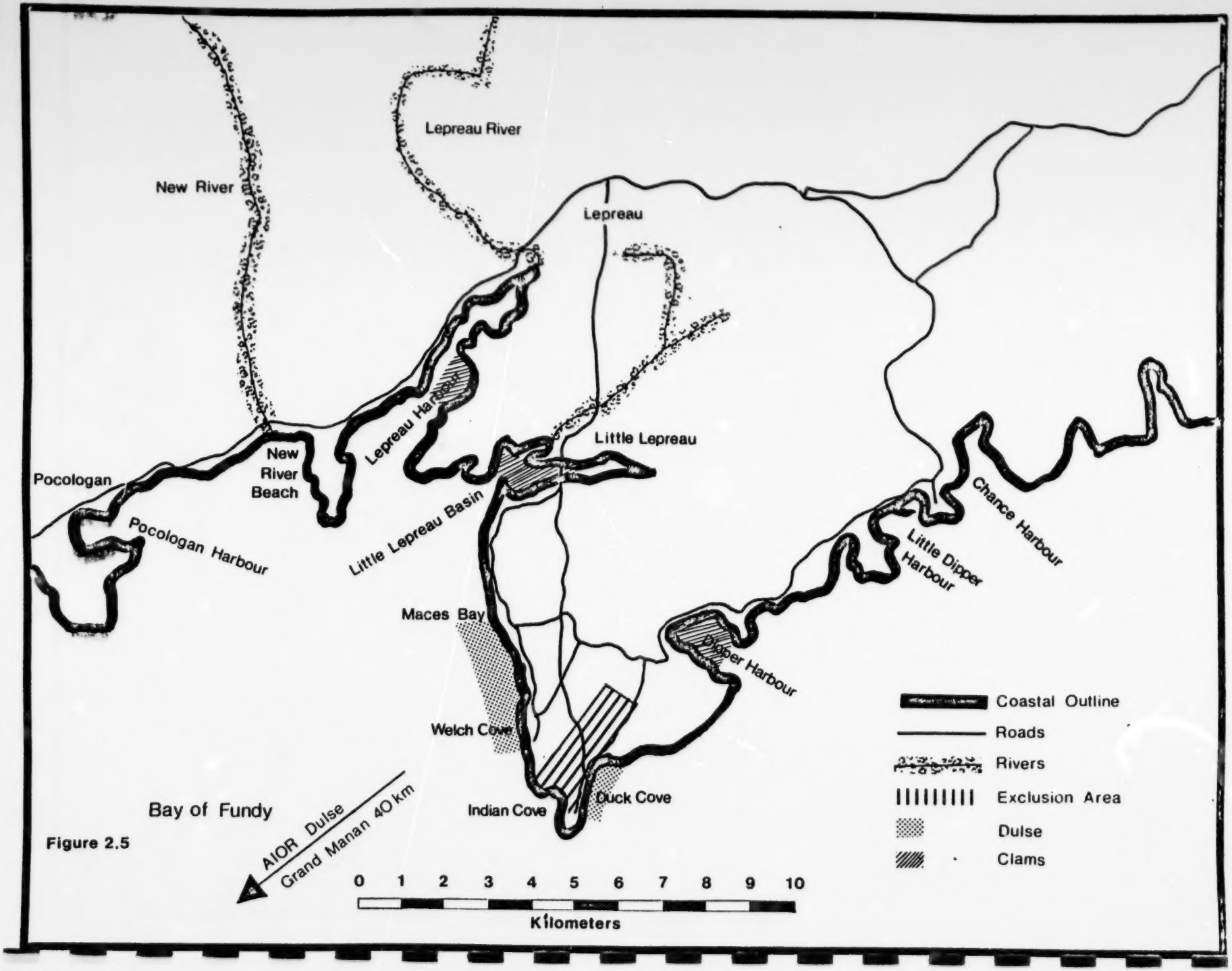
GOI
HO3
Duck Cove
Indian Cove
Bay of Fundy
0 1 2 3 4 5 6 7 8 9 10
Kilometers
Coastal Outline
Roads
Rivers
Exclusion Area
Sediment Analyses
Gamma Surveys

Figure 2.4


Lepreau River
New River
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Little Lepreau Basin
Chance Harbour
Little Dipper Harbour
Maces Bay
Dipper Harbour
Welch Cove
Duck Cove
Indian Cove
Bay of Fundy
AIOR Dulse
Grand Manan 40 km
0 1 2 3 4 5 6 7 8 9 10
Kilometers
Coastal Outline
Roads
Rivers
Exclusion Area
Dulse
Clams

Figure 2.5

3.0 STATISTICS, ANALYTICAL TECHNIQUES, SAMPLE COLLECTION

3.1 Introduction

This section provides a summary of statistics, analytical techniques, analyses and detection limits used in the Health Physics Environmental Laboratory.

3.2 Statistics

The following statistical conventions are applied in the analysis of each sample:

1) Detection limits are defined following the method described by Lochamy (NBS Special Publication 456 - Measurements for the Safe Use of Radiation, U.S. Department of Commerce, 1976). The Lower Limit of Detection (LLD) at the 99% confidence level is defined as 6.58 Sb, where Sb is the standard deviation of the appropriate, ill-defined, background measurement. Such an ill-defined background is typical of the germanium detector analyses, liquid scintillation analyses and alpha/beta determinations. This LLD corresponds to that amount of activity in a sample that will yield a net count greater than 3.29 Sb, i.e., the so-called Critical Level (CL), with 99% probability.
The LLD specifies the theoretical capability of the system to quantify a given amount of radioactivity, whereas the CL is used to determine in practice whether a single activity measurement should be considered "detected". Any individual measurement greater than 3.29 Sb is considered detected at the 99% confidence level. This also implies a 1% probability of stating that activity is present when it is not (false positive). If activity is present at the LLD level (6.58 Sb) there is a 1% probability of stating that activity is not present when it is (false negative).
In most of the tables of data (Section 4.0), it is this Critical Level that appears in column 1. Where there are sufficient background data to provide a well defined background as for example with the TLD data, the CL is defined as 2.33 Sb and the LLD as 4.66 Sb.

2) Unless otherwise indicated, the precision of the measurements reported here is given as +- 1.96 Sa (95% confidence level), where Sa is the standard deviation of the activity measurement.

3) The value and standard deviation are reported with two significant figures using modified scientific notation, for example 0.032 is expressed as 3.2E-02.

3.3 Analytical Techniques

The major analytical techniques and the instruments used in routine environmental analysis are summarized in Table 3.1. In the case of gamma spectrometry analysis, all significant peaks in the spectrum are identified either by reference to a library of about 100 radionuclides in a computer file, or by manual reference to compilations of all known radionuclides. In addition, approximately 20 'selected' radionuclides are specifically searched for in every sample with the exception of Air Iodine samples in which only I-131 is 'selected'. The 'selected' radionuclides include those which are produced in PLGS and which would be readily detectable because of their abundance (high fission yield) and high branching ratios for gamma emissions. Naturally occurring gamma emitters - daughter radionuclides of uranium and thorium; cosmogenic radionuclides and any of the 18 or so known radioactive species found in nature - are present in most samples, but with the exception of Be-7, K-40 and Ac-228 are not included in this report. The latter radionuclides are sometimes useful as general indicators of the consistency of the analytical techniques and are thus reported.

The usefulness of alpha/beta analysis lies primarily in screening samples to determine whether or not more detailed analyses should be performed. The reported alpha and beta values are assessed using Am-241 and Sr-Y-90 calibration sources respectively.

Wet chemical analyses for strontium-90 on Gaseous Effluent (airborne) Monitor (GEM) and Liquid Effluent Monitor (LEM) samples covering the entire year are included in the environmental monitoring program.
Analysis of these PLGS source samples provides sufficient information on emissions of Sr-90 (and of Sr-89 if the count rates allow it) to indicate whether or not it is worthwhile analyzing the 200 or more air particulate or other samples for this radionuclide. Emissions of Sr-90 in 1986, were sufficiently low that environmental samples were not routinely analyzed for this radionuclide. However, to collect data on the Chernobyl accident, eight of the air monitoring filters which showed the highest activity levels of radionuclides from Chernobyl were analyzed for strontium-90. With one exception, strontium-90 was not detected. The data are given in Appendix 1.

TABLE 3.1

SUMMARY OF ANALYTICAL TECHNIQUES

Analytical technique	Instrumentation
Gamma Spectroscopy	A Canberra 24% efficient * intrinsic germanium detector, in an Applied Physical Technology 10 cm graded lead cave. A NaI (7.6 x 7.6 cm) detector in an APT 10 cm graded lead cave. Ortec Model 7010 multichannel analyser (4096 channels). Hewlett-Packard 9845B microcomputer for automatic data reduction (20 megabyte hard disc storage capacity).
Liquid Scintillation (Tritium and C-14)	Beckman LS-100C counter
Gross Alpha/Beta and Sr-90 Analyses	Tennelec LB-5100 alpha/beta detector.
Thermoluminescence Dosimetry	Panasonic UD-710A Automatic TLD Reader and UD-814AQ dosimeters.
Chemical analysis, Ion exchange separation	Laboratory separation and analysis for Sr-90 on various sample types. The final analysis is by Tennelec alpha/beta counting.

* relative to a sodium iodide detector.

3.4 Sample Collection, Analysis and Detection Limits

3.4.1 Airborne Particulates

Collection

Airborne particulates are collected on a 47 mm diameter Gelman Type A glass fibre filter through which air is drawn at 60 L/min (approximately 1200 m^3 for a 14 day continuous sample). The volume of air sampled is measured with an in-line integrating dry gas meter. Every two weeks the filters are replaced and the used ones returned to the laboratory for analysis. Sampling is therefore continuous throughout the year, the only interruption, other than because of power failure or pump breakdown, being the five minute filter change. Less than 1% of collection time was lost due to breakdown and power failures.

Analysis and Detection Limits

Air particulate filters are analyzed by gamma spectrometry as soon as possible after collection to ensure detection of any short lived gamma emitters that may be present, and to minimize any decay corrections. Samples are counted for 5000 s on a 24% efficient intrinsic germanium gamma spectrometer. Typical LLDs are given in Table 3.2 for a 1200 m^3 sample. The LLDs are decay corrected to the time of sample collection. Throughout this section and in the data tables, the radionuclides are listed in order of increasing 'selected' photon energy, (exceptions to this are the additional data for gross alpha, gross beta, tritium and ruthenium-106). Ru-106 is a pure beta emitter only, but is a long lived parent of the short half life rhodium-106 which is used for the analysis. Decay corrections are based upon the parent half life.

Approximately three days after the end of the sample collection, each filter is counted for 100 minutes for the simultaneous determination of gross alpha and gross beta activity. Counting is delayed for this length of time to allow for the decay of activity of the short-lived naturally occurring radon daughters which are present in all of these samples and which would otherwise complicate the analysis.

TABLE 3.2

LLDs ON AIR PARTICULATE SAMPLES

Nuclide	LLD (Bq/m³)
Gross alpha	4E-05
Gross beta	8E-05
Ce-144	1E-03
Ce-141	4E-04
Cr-51	2E-03
I-131	4E-04
Be-7	4E-03
Ru-103	2E-04
Ba-140	1E-03
Cs-134	2E-04
Ru-106	2E-03
Cs-137	2E-04
Zr-95	4E-04
Nb-95	2E-04
Co-58	2E-04
Mn-54	2E-04
Ag-110m	4E-04
Ac-228	8E-04
Fe-59	6E-04
Zn-65	8E-04
Co-60	4E-04
K-40	6E-03
La-140	4E-04

3.4.2 Airborne Radioiodine

Collection

Airborne radioiodine is collected in an activated charcoal cartridge placed downstream from the glass fibre filter used to collect the airborne particulates. The cartridges used are Nuclear Consulting Services NUSORB (47 mm diameter and 48 mm length) charcoal cartridges containing 5% TEDA by weight. For a 14-day continuous sample approximately 1200 m³ of air is sampled at a flow rate of 60 L/min. The volume of air sampled is measured with an in-line integrating dry gas meter.

Analysis and detection limits

I-131 is the major nuclide of interest on the charcoal cartridges. The cartridges are analyzed for 5000 s on the gamma spectrometer as soon as possible after collection because of the relatively short half life of I-131 (8 days). Other fission product radioiodines, with much shorter half lives (minutes to hours), decay before they reach the sample location or during the time the sample is being collected. A typical LLD for I-131 is about 4E-04 Bq/m³ of air.

3.4.3 Airborne Tritium

Collection

A fraction of the flow in the air monitoring sample train is diverted through a molecular sieve container where water vapour is trapped. The volume of air passed through the molecular sieve is measured with an in-line integrating dry gas meter. The sieve material is later heated to 450°C and the water driven off is condensed and collected for analysis. Sampling is continuous at each location throughout the year, but is interrupted for a few minutes every four weeks to exchange sieve containers. Since the amount of water absorbed by the molecular sieve from a given volume of air depends upon relative humidity, flow rates are adjusted seasonally (using a Dwyer flow meter) to avoid saturation of the sieve material and to ensure adequate sample collection.

Analysis and Detection limits

For tritium analysis by liquid scintillation techniques, 6 mL of water taken from the molecular sieve are mixed with 15 mL of Aquasol-II, and counted for 100 minutes. The LLD is approximately 1E-01 Bq/m^3 of air for a typical sample, corresponding to about 1E-03% of the tritium DAC for the general public.

3.4.4 Airborne Carbon-14

Collection

Airborne carbon dioxide is collected in a 1 litre volume of 1.0 Normal caustic soda solution at two environmental monitoring locations. One is at the Lighthouse location (G02), and the other is at the Information Centre (H04). The volume of air sampled is assessed by gravimetric analysis of the dissolved carbon dioxide precipitated from solution as barium carbonate.

Analysis and Detection Limits

Carbon-14 is determined by liquid scintillation analysis of a 6 mL aliquot of the solution in 15 mL of Aquasol-II. The LLD is about 0.5 Bq/m^3 of air.

3.4.5 Environmental Gamma Radiation

Thermoluminescence Dosimetry (TLD)

Environmental gamma radiation is measured by thermoluminescence dosimetry for each of 36 locations on a quarterly basis, (six locations were added this year). The phosphor is contained in a holder comprising three elements of lead-filtered calcium sulphate and one of lithium borate. The assembly, heat sealed in

plastic and further protected in a thin walled plastic bag, is suspended about 1 m above the ground. The LLD at the 99% confidence level (i.e., 4.66 standard deviations above a well defined background) is approximately 10 microgray. All background radiation measurements are considerably higher than this.
The expected precision is about +-10% at the 95% confidence level.

If a quarterly measurement is not available (lost TLD, moisture penetration, etc.) a mean value is calculated from the available measurements in order to provide an estimate for the annual total.
The statistical uncertainty in the annual total is the square root of the sum of the squares of the uncertainties of the individual quarterly measurements.

Environmental Dose Rate Survey Measurements

Gamma dose rate measurements (Beach Surveys) are taken quarterly on beaches and mud flats in the Point Lepreau area with an environmental gamma survey meter (Nuclear Enterprises type PDR1 or equivalent, capable of determining ambient radiation levels down to about 0.05 microgray/hour). In these inter-tidal locations it would be impracticable to use TLDs.

3.4.6 Sediment

Collection and preparation

Beach and mudflat sediments (sand, silt and clay) are collected near the low tide mark with preference being given to the top 50 mm of the finely-divided silts characteristic of tidal mud flats. Disposable polyethylene containers are used to collect about 2 kg of sample which is later transferred to disposable aluminum trays for drying. Dried caked samples are broken into their original free granular form with a porcelain mortar and pestle and sieved through a 0.2 mm sieve to collect the fines for analysis (a 1 mm sieve is used for coarse sediments).

Analysis and Detection Limits

Approximately 0.25 kg of dried sediment is counted for 5000 s on the gamma spectrometry system.

TABLE 3.3

LLD IN SEDIMENTS

Nuclide	LLD (Bq/kg)
Ce-144	2E+01
Ce-141	8E+00
Cr-51	4E+01
I-131	8E+00
Be-7	4E+01
Ru-103	2E+00
Ba-140	2E+01
Cs-134	4E+00
Ru-106	4E+01
Cs-137	6E+00
Zr-95	6E+00
Nb-95	2E+00
Co-58	2E+00
Mn-54	4E+00
Ag-110m	4E+00
Ac-228	4E+01
Fe-59	6E+00
Zn-65	4E+00
Co-60	4E+00
K-40	2E+01
La-140	1E+01

3.4.7 Water (Well Water/Sea Water)

Collection and Analysis

A 4 litre sample of well water or sea water is collected and acidified with 15 mL of concentrated Nitric acid. About 20 mL of each sample, taken out before acidification, are used for tritium analysis (the sea water is distilled). Well water samples (250-500 mL, depending upon the dissolved solids content) are evaporated to dryness on stainless steel planchets for gross alpha/beta analysis.
Other water samples collected and analyzed include those at the SRWMF, i.e., Bore Hole waters, Cell Drainage water (if present) and surface run-off collected in the Parshall Flume. Lagoon water and lagoon sludge samples from within the PLGS exclusion boundary are also analyzed.

Analysis and Detection Limits

For gross alpha/beta analysis of well water, dried samples are counted for 100 minutes on a Tennelec LB-5100 alpha/beta counting system.
For tritium analysis, a 6 mL sample of fresh water or sea water distillate is mixed with 15 mL of Aquasol-II and counted for 100 minutes by liquid scintillation. For gamma spectrometry analysis a 3.6 litre sample is counted for 5000 s on the gamma spectrometer. Typical LLDs are listed below.

TABLE 3.4

LLD IN WELL WATER AND SEA WATER

Nuclide	Well Water LLD (Bq/L)	Sea Water LLD (Bq/L)
Gross alpha	1E-01	NA
Gross beta	1E-01	NA
H-3	4E+01	4E+01
Ce-144	2E+00	4E+00
Ce-141	1E+00	6E-01
Cr-51	4E+00	4E+00
I-131	4E-01	4E-01
Be-7	4E+00	2E+00
Ru-103	4E-01	4E-01
Ba-140	2E+00	2E+00
Cs-134	4E-01	4E-01
Ru-106	4E+00	2E+00
Cs-137	4E-01	4E-01
Zr-95	6E-01	6E-01
Nb-95	4E-01	4E-01
Co-58	4E-01	4E-01
Mn-54	4E-01	4E-01
Ag-110m	6E-01	4E-01
Ac-228	1E+00	1E+00
Fe-59	1E+00	8E-01
Zn-65	8E-01	6E-01
Co-60	6E-01	4E-01
K-40	1E+01	4E+00
La-140	1E+00	6E-01

NA - Not applicable. Sea water contains relatively high levels of natural radioactivity from K-40 and large amounts of dissolved salts which would interfere with these determinations.

3.4.8 Milk

Collection

A 4 litre sample of milk is collected for gamma spectrometric analysis and if necessary preserved by addition of 15 mL of formaldehyde solution. Distillate from an aliquot of the same sample, before addition of preservative, is used for tritium analysis.

Analysis and Detection Limits

For tritium analysis by liquid scintillation techniques, a 6 mL sample of distillate is mixed with 15 mL of Aquasol-II and counted for 100 minutes.

For gamma spectrometric analysis, a 3.6 litre sample is analyzed for 50000 s (overnight) on a 24% efficient intrinsic germanium detector. Typical LLDs for the nuclides of interest in milk are listed below.

TABLE 3.5

LLD IN MILK

Nuclide	LLD (Bq/L)
H-3	4E+01
Ce-144	1E+00
Ce-141	2E-01
Cr-51	1E+00
I-131	1E-01
Be-7	1E+00
Ru-103	1E-01
Ba-140	8E-01
Cs-134	1E-01
Ru-106	1E+00
Cs-137	2E-01
Zr-95	2E-01
Nb-95	2E-01
Co-58	2E-01
Mn-54	2E-01
Ag-110m	1E-01
Ac-228	6E-01
Fe-59	4E-01
Zn-65	4E-01
Co-60	2E+00
K-40	2E+00
La-140	2E-01

3.4.9 Seafood

Collection and Preparation

Approximately 0.5 to 2 kg of fresh seafood is collected for analysis. The crabs, lobsters and periwinkles are cooked before analysis to facilitate removal of the meat. Only the edible fraction of the various seafoods is analyzed. Dulse (Rhodymenia palmata) is the most commonly harvested edible seaweed in the Point Lepreau area. Irish Moss, (Chondrus crispus), is commercially important in other areas of the Bay of Fundy, i.e., St. Mary's Bay, but is not harvested in the Point Lepreau area. Other species of seaweed, e.g., Laminaria and Ascophylum have been examined for their commercial possibilities, but they are not currently harvested.

Analysis and Detection Limits

Approximately 0.25 kg of each prepared sample is counted for 5000 s on a 24% efficient gamma spectrometer. Typical LLDs are given below.

TABLE 3.6

LLD IN SEAFOOD (EDIBLE FRACTION)

Nuclide	LLD (Bq/kg)
Ce-144	1E+01
Ce-141	4E+00
Cr-51	1E+01
I-131	2E+00
Be-7	2E+01
Ru-103	4E+00
Ba-140	4E+00
Cs-134	2E+00
Ru-106	1E+01
Cs-137	2E+00
Zr-95	2E+00
Nb-95	2E+00
Co-58	2E+00
Mn-54	2E+00
Ag-110m	2E+00
Ac-228	8E+00
Fe-59	4E+00
Zn-65	4E+00
Co-60	2E+00
K-40	2E+01
La-140	2E+00

3.4.10 Vegetation

Collection and Preparation

The only vegetation types routinely collected and analyzed are tree lichen (Spanish moss) and various ground mosses such as Cladonia and Lycopodium. About 100 g or more of each of the samples is collected and air dried before analysis. No special preparation is required. Reference samples are collected from the Fredericton area.

Analysis and Detection Limits

Samples are analyzed for 5000 s on a 24% efficient gamma detector. Typical LLDs for a 100 g sample of lichen are given below.

TABLE 3.7

LLD IN VEGETATION

Nuclide	LLD (Bq/kg)
Ce-144	4E+01
Ce-141	1E+01
Cr-51	5E+01
I-131	9E+00
Be-7	5E+01
Ru-103	7E+00
Ba-140	3E+01
Cs-134	2E+01
Ru-106	6E+01
Cs-137	7E+00
Zr-95	8E+00
Nb-95	1E+01
Co-58	6E+00
Mn-54	4E+00
Ag-110m	8E+00
Ac-228	2E+01
Fe-59	8E+00
Zn-65	1E+01
Co-60	6E+00
K-40	4E+01
La-140	2E+01

4.0 SUMMARY TABLES OF ENVIRONMENTAL DATA

The following tables provide a summary of the environmental data collected during the period January 01, 1986 to December 31, 1986.

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All tables (except Tables 4.03B, 4.03C, 4.04, 4.05A, 4.05B, 4.06, 4.07B, 4.24A, and 4.24B) contain the following data:

Column 1 - Shows the type of analysis or nuclide and, in parentheses, the total number of samples analysed.

Column 2 - Shows the mean of the Critical Levels (CLs) for all samples and, in parentheses, the range of the CLs. Any measurement greater than the CL is considered detected at the 99% confidence level.

Column 3 - Shows the mean of the detected values (i.e., values exceeding the CL) for all indicator stations, followed in parentheses by the ratio (F) of the number of detected values to the total number of indicator samples. Values less than or equal to the CL are not

included in the mean. The second line of the column indicates the range of detected values for the indicator stations.

Column 4 - Shows the location code for the indicator station with the largest value. Refer to the maps of section 2 for sample locations.

Column 5 - Shows the mean of detected values for the indicator station with the largest value, followed in parentheses by the ratio (F) of the number of detected values to the total number of samples for this indicator station. The second line of this column contains the range of detected values for this location.

Column 6 - Shows the mean of detected values at the Reference location(s), followed in parentheses by the ratio (F) of detected values to the total number of samples at this location. The second line of this column contains the range of detected values for the Reference location(s).

There are several exceptions to the above format:

(1) Tables 4.03B and 4.03C list all tritium-in-air data for all air monitoring locations.

(2) Table 4.04 lists the carbon-14 in air data at the G02 and H04 air monitoring locations.

(3) Table 4.05A lists the environmental TLD data for each quarter. Table 4.05B is a summary of the last nine years of environmental TLD results.

(4) Table 4.06 lists the environmental gamma survey measurements (Beach Surveys) taken quarterly.

(5) Table 4.07B is a summary of Cs-137 data in sediments since 1978.

(6) Tables 4.24A and 4.24B tabulate the Sr-90 determinations on the GEM and LEM samples respectively.

SUMMARY TABLES OF DATA

TABLE 4.01 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

AIRBORNE PARTICULATE (FILTER) Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Gross-A (208)	5.9E-06 (2.5E-06-4.0E-05)	2.8E-05 (172/182) (6.0E-06-1.1E-04)	F01	3.0E-05 (25/ 26) (6.8E-06-1.1E-04)	2.9E-05 (26/ 26) (1.0E-05-1.1E-04)
Gross-B (208)	1.6E-05 (7.7E-06-9.8E-05)	8.1E-04 (182/182) (1.3E-04-5.4E-03)	I01	8.5E-04 (26/ 26) (1.9E-04-5.4E-03)	8.6E-04 (26/ 26) (1.8E-04-5.7E-03)
Ce-144 (208)	2.3E-04 (9.8E-05-1.4E-03)	*		*	*
Ce-141 (208)	6.4E-05 (3.1E-05-4.0E-04)	*		*	*
Cr-51 (208)	4.4E-04 (2.2E-04-3.0E-03)	*		*	*
I-131 (208)	1.0E-04 (3.8E-05-7.9E-04)	1.3E-03 (19/182) (1.6E-04-3.9E-03)	F01	1.9E-03 (2/ 26) (2.4E-04-3.6E-03)	1.4E-03 (3/ 26) (2.4E-04-3.7E-03)
Be-7 (208)	4.7E-04 (2.0E-04-3.5E-03)	2.6E-03 (178/182) (9.9E-04-5.2E-03)	F01	2.8E-03 (25/ 26) (1.2E-03-5.2E-03)	2.5E-03 (25/ 26) (1.5E-03-4.8E-03)
Ru-103 (208)	5.3E-05 (1.5E-05-2.8E-04)	7.4E-04 (24/182) (1.4E-04-1.6E-03)	F01	8.4E-04 (3/ 26) (3.4E-04-1.4E-03)	7.5E-04 (4/ 26) (1.8E-04-1.6E-03)
Ba-140 (208)	2.8E-04 (1.0E-04-1.7E-03)	*		*	*
Cs-134 (208)	4.9E-05 (2.0E-05-2.8E-04)	5.6E-04 (21/182) (2.0E-04-8.6E-04)	K02	6.2E-04 (3/ 26) (4.0E-04-8.4E-04)	5.4E-04 (3/ 26) (3.5E-04-7.0E-04)
Ru-106 (208)	4.6E-04 (1.4E-04-2.3E-03)	9.9E-04 (3/182) (7.6E-04-1.3E-03)	K02	1.3E-03 (1/ 26) (1.3E-03-1.3E-03)	*
Cs-137 (208)	5.3E-05 (2.0E-05-2.8E-04)	1.1E-03 (23/182) (7.3E-05-1.7E-03)	K02	1.3E-03 (3/ 26) (1.0E-03-1.5E-03)	1.3E-03 (3/ 26) (8.7E-04-1.6E-03)
Zr-95 (208)	8.9E-05 (2.2E-05-4.4E-04)	*		*	*
Nb-95 (208)	5.2E-05 (2.1E-05-3.6E-04)	*		*	*

TABLE 4.01 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

AIRBORNE PARTICULATE (FILTER) Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Co-58 (208)	4.9E-05 (2.0E-05-3.4E-04)	*		*	*
Mn-54 (208)	4.8E-05 (2.1E-05-2.0E-04)	*		*	*
Ag-110m (208)	6.4E-05 (2.6E-05-3.4E-04)	*		*	*
Ac-228 (208)	1.8E-04 (6.0E-05-1.1E-03)	*		*	*
Fe-59 (208)	1.1E-04 (4.5E-05-8.9E-04)	*		*	*
Zn-65 (208)	1.2E-04 (3.9E-05-7.1E-04)	*		*	*
Co-60 (208)	6.3E-05 (2.1E-05-2.7E-04)	*		*	*
K-40 (208)	9.8E-04 (1.4E-04-6.1E-03)	1.1E-03 (9/182) (6.0E-04-1.8E-03)	H04	1.6E-03 (2/ 26) (1.6E-03-1.6E-03)	1.0E-03 (2/ 26) (7.7E-04-1.2E-03)
La-140 (208)	1.2E-04 (4.0E-05-5.0E-04)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.02 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

AIRBORNE IODINE (CHAR. CART.) Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Mean (F) (Range)	Reference Station Mean (F) (Range)
I-131	8.6E-05	3.6E-03 (21/182)	I01	4.0E-03 (3/ 26)	3.7E-03 (3/ 26)
(208)	(3.6E-05-7.5E-04)	(3.3E-04-8.9E-03)		(6.7E-04-8.9E-03)	(7.8E-04-7.6E-03)

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.03A

87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

AIRBORNE TRITIUM (SIEVE) Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3	1.1E-01	1.3E+00 (81/ 91)	K02	3.4E+00 (13/ 13)	1.3E-01 (1/ 13)
(104)	(1.2E-02-5.1E-01)	(5.2E-02-9.1E+00)		(7.6E-01-9.1E+00)	(1.3E-01-1.3E-01)

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.03B

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

Tritium in Air (Bq/m3) — Air Monitoring Stations

PERIOD*	A01R Bocabec	E01 Maces Bay	F01 Welch Cove	G02 Lepreau Light.	H04 Info. Centre	I01 SE##F	K02 PLGS Pumphouse	M01 Dipper Hbr.
##	45.	4.5	1.5	1.0	0.75	1.0	0.15	3.8
1	<2.3E-2	5.2E-2	6.0E-1	7.2E-1	8.4E-1	4.3E-1	2.9E+0	5.4E-2
2	<8.2E-2	5.8E-2	2.8E-1	4.5E-1	7.9E-1	4.6E-1	2.6E+0	1.7E-1
3	<2.6E-2	<8.4E-2	6.1E-2	2.0E-1	1.7E+0	3.6E-1	3.0E+0	1.8E-1
4	<1.0E-1	1.1E-1	2.9E-1	7.5E-1	1.8E+0	1.2E+0	4.1E+0	3.5E-1
5	1.3E-1	1.8E-1	6.1E-1	2.0E+0	2.3E+0	8.6E-1	9.1E+0	2.2E-1
6	<1.5E-1	<3.0E-1	3.0E-1	1.0E+0	2.5E+0	9.5E-1	5.6E+0	5.1E-1
7	<2.1E-1	<3.0E-1	6.2E-1	1.8E+0	3.0E+0	2.1E+0	7.2E+0	9.7E-1
8	<2.4E-1	<2.3E-1	<1.7E-1	4.9E-1	1.3E+0	9.6E-1	2.9E+0	3.5E-1
9	<2.7E-1	<4.5E-1	<2.3E-1	1.3E+0	2.1E+0	1.9E+0	3.0E+0	5.2E-1
10	<2.3E-1	<2.4E-1	2.1E-1	7.9E-1	2.3E+0	1.6E+0	7.6E-1	5.0E-1
11	<1.1E-1	<1.8E-1	<1.7E-1	1.3E+0	3.0E+0	1.4E+0	7.9E-1	5.2E-1
12	<1.0E-1	7.9E-2	6.8E-2	7.1E-1	9.0E-1	1.0E+0	9.1E-1	1.1E-1
13	<5.1E-2	6.3E-2	2.1E-1	5.0E-1	1.1E+0	4.7E-1	9.7E-1	1.1E-1

* The periods are approximately of four weeks duration so there are between 12 and 13 periods in the year. All sample stations are changed at the same time.

kilometres from PLGS stack.

Values with a < symbol were not detected.

TABLE 4.03C

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
76-01-01 to 86-12-31

AIRBORNE TRITIUM (MOLECULAR SIEVE) Bq/m3

Year. Samples Analysed	Critical Level Mean (Range)	Indicator Stations Mean(F) (Range)	Reference Station Mean(F) (Range)
1976 to 1979			
68 *	8.0E-2	1.2E-1 (13/54)	2.6E-1 (3/14)
	(1.5E-2 to 2.1E-1)	(2.1E-2 to 5.6E-1)	(2.6E-2 to 7.2E-1)
1979			
48	6.1E-2	1.1E-1 (6/38)	1.1E-1 (1/10)
	(1.1E-3 to 2.0E-1)	(3.4E-3 to 3.0E-1)	(1.1E-1 to 1.1E-1)
1980			
56	9.9E-2	3.7E-1 (15/44)	2.2E-1 (2/12)
	(2.6E-2 to 3.3E-1)	(8.5E-2 to 3.0E+0)	(8.9E-2 to 3.4E-1)
1981			
52	9.2E-2	1.9E-1 (3/46)	7.6E-1 (2/6)
	(1.3E-2 to 2.4E-1)	(1.2E-1 to 3.3E-1)	(4.3E-1 to 1.1E+0)
1982			
72	5.7E-2	2.2E-1 (18/62)	4.9E-2 (2/10)
	(2.2E-2 to 5.2E-1)	(2.6E-2 to 2.0E+0)	(3.7E-2 to 6.1E-2)
1983			
94	4.5E-2	2.4E-1 (52/82)	1.7E-1 (4/12)
	(2.0E-2 to 1.7E-1)	(3.4E-2 to 1.3E+0)	(8.0E-2 to 2.7E-1)
1984			
101	1.0E-1	7.1E-1 (73/88)	1.4E-1 (2/13)
	(2.3E-2 to 2.7E-1)	(6.0E-2 to 5.6E+0)	(1.0E-1 to 1.8E-1)
1985			
104	7.5E-2	5.7E-1 (77/91)	8.0E-2 (1/13)
	(1.4E-2 to 2.8E-1)	(1.5E-2 to 3.3E+0)	(8.0E-2 to 8.0E-2)
1986			
104	1.1E-1	1.3E+0 (81/91)	1.3E-1 (1/13)
	(1.2E-2 to 5.1E-1)	(5.2E-2 to 9.1E+0)	(1.3E-1 to 1.3E-1)

F Number of analyses greater than the Critical Level/total number of analyses.

* This number includes the 48 samples analyzed and quoted separately for 1979.

TABLE 4.04

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

Carbon-14 in Air Monitoring Samples (Bq/m3). Caustic Bubbler

START DATE	STOP DATE	G02 Lighthouse	H04 Information Centre
86-01-02	86-01-28	<9E-01	<2E-01
86-01-28	85-02-27	<2E-01	<2E-01
86-02-27	86-04-09	<1E-01	<2E-01
86-04-09	86-05-14	<1E-01	<2E-01
86-05-14	86-06-11	<2E-01	<2E-01
86-06-11	86-07-09	<3E-01	<3E-01
86-07-09	86-08-07	<2E-01	<3E-01
86-08-07	86-09-04	<2E-01	<3E-01
86-09-04	86-10-01	<3E-01	<4E-01
86-10-01	86-11-06	<4E-01	<2E-01
86-11-06	86-12-02	4E-01	<6E-01
86-12-02	87-01-05	<5E+00 *	<3E-01

Precision is +- 2E-01 Bq/m3 at 95% confidence.

* High LLD due to low air volume sampled because of pump malfunction.

TABLE 4.05A 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Year
1986

TLD (ENVIRONMENTAL) uGy +- 10%

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
A01R	189 +- 19	230 +- 23	231 +- 23	198 +- 20	850 +- 40
B03	186 +- 19	244 +- 24	251 +- 25	194 +- 19	880 +- 40
C03	191 +- 19	268 +- 27	213 +- 21	214 +- 21	890 +- 40
D02	192 +- 19	261 +- 26	252 +- 25	213 +- 21	920 +- 50
E01	179 +- 18	238 +- 24	234 +- 23	187 +- 19	840 +- 40
E04	159 +- 16	213 +- 21	191 +- 19	179 +- 18	740 +- 40
F01	147 +- 15	199 +- 20	185 +- 19	147 +- 15	680 +- 30
G02	186 +- 19	201 +- 20	197 +- 20	174 +- 17	760 +- 40
H04	160 +- 16	196 +- 20	186 +- 19	166 +- 17	710 +- 40
H05	182 +- 18	197 +- 20	214 +- 21	170 +- 17	760 +- 40
I00A	235 +- 23	266 +- 27	265 +- 27	257 +- 26	1020 +- 50
I00B	234 +- 23	316 +- 32	271 +- 27	254 +- 25	1080 +- 50
I00C	249 +- 25	290 +- 29	258 +- 26	258 +- 26	1060 +- 50
I00D	242 +- 24	290 +- 29	290 +- 29	247 +- 25	1070 +- 50
I00E	226 +- 23	286 +- 29	273 +- 27	242 +- 24	1030 +- 50
I00F	223 +- 22	312 +- 31	272 +- 27	238 +- 24	1050 +- 50
I00G	238 +- 24	291 +- 29	251 +- 25	245 +- 24	1030 +- 50
I00H	237 +- 24	300 +- 30	300 +- 30	256 +- 26	1090 +- 60
I00I	218 +- 22	280 +- 28	274 +- 27	249 +- 25	1020 +- 50
I00J	222 +- 22	302 +- 30	253 +- 25	240 +- 24	1020 +- 50
I00K	208 +- 21	274 +- 27	237 +- 24	216 +- 22	940 +- 50
I00L	210 +- 21	282 +- 28	242 +- 24	233 +- 23	970 +- 50
I75	NA	NA	316 +- 32	255 +- 26	1140 +- 40
J00	NA	NA	248 +- 25	230 +- 23	960 +- 30
J20	NA	NA	252 +- 25	250 +- 25	1000 +- 40
J35	NA	NA	217 +- 22	231 +- 23	900 +- 30
J70	NA	NA	426 +- 43	363 +- 36	1580 +- 60
K01	198 +- 20	269 +- 27	236 +- 24	226 +- 23	930 +- 50
K02	218 +- 22	258 +- 26	244 +- 24	227 +- 23	950 +- 50
L01	188 +- 19	230 +- 23	216 +- 22	179 +- 18	810 +- 40
L02	216 +- 22	302 +- 30	301 +- 30	249 +- 25	1070 +- 50
L03	173 +- 17	200 +- 20	215 +- 22	159 +- 16	750 +- 40
M02	NA	NA	308 +- 31	284 +- 28	1180 +- 40
N01	189 +- 19	257 +- 26	221 +- 22	216 +- 22	880 +- 40
P01	154 +- 15	192 +- 19	180 +- 18	151 +- 15	680 +- 30
P03	158 +- 16	NA	201 +- 20	170 +- 17	710 +- 30

NA : Data not available

TABLE 4.05B

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses
1978 - 1986

TLD (ENVIRONMENTAL)				uGy			Annual absorbed dose		
Location	1978	1979	1980	1981	1982	1983	1984	1985	1986
A01R	760	660	660	750	960	840	750	900	850
B03	960	840	740	670	840	820	780	890	880
C03	930	900	850	820	870	910	810	940	890
D02	730	880	810	790	860	890	880	920	920
E01	600	850	670	620	890	740	680	800	840
E04	690	940	800	730	850	710	710	790	740
F01	730	780	960	790	810	650	600	690	680
G02	760	880	780	690	850	720	690	770	760
H04	560	730	540	590	770	650	650	720	710
H05	750	760	670	640	760	720	680	760	760
I00A +	NA	NA	850*	780	970	980	930	1090	1020
I00B +	NA	NA	960*	1040	990	970	970	1110	1080
I00C +	NA	NA	840*	930	1010	960	1000	1110	1060
I00D +	NA	NA	800*	920	960	970	950	1090	1070
I00E +	NA	NA	830*	890	920	950	970	1030	1030
I00F +	NA	NA	830*	930	900	940	960	1070	1050
I00G +	NA	NA	840*	960	940	910	910	1100	1030
I00H +	NA	NA	850*	1000	1010	960	960	1100	1090
I00I +	NA	NA	780*	970	920	930	910	1070	1020
I00J +	NA	NA	890*	910	850	880	910	1030	1020
I00K +	NA	NA	750*	820	920	880	920	1030	940
I00L +	NA	NA	920*	1070	900	960	920	1040	970
I75 *	NA	NA	NA	NA	NA	NA	NA	NA	1140
J00 *	NA	NA	NA	NA	NA	NA	NA	NA	960
J20 *	NA	NA	NA	NA	NA	NA	NA	NA	1000
J35 *	NA	NA	NA	NA	NA	NA	NA	NA	900
J70 *	NA	NA	NA	NA	NA	NA	NA	NA	1580
K01	690	1090	830	790	900	850	820	940	930
K02	NA	NA	NA	NA	NA	830	850	920	950
L01	710	880	790	680	830	780	750	850	810
L02	840	1000	870	930	990	920	910	1020	1070
L03	550	660	640	570	770	650	630	720	750
M02 *	NA	NA	NA	NA	NA	NA	NA	NA	1180
N01	780	1040	660	680	890	850	800	920	880
P01	560	690	550	490	660	610	580	670	680
P03	710	730	650	680	750	720	690	790	710

* The I75, J and M locations were established in 1986.

\+ These I00 locations were previously identified as I04.

NA TLDs not used in these locations at this time.

TABLE 4.06

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

ENVIRONMENTAL GAMMA SURVEYS (BEACH) — microgray/h * — INTERTIDAL ZONES

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4
B01	0.07	0.06	0.13	0.13
C01	0.08	0.09	0.15	0.18
D01	0.09	0.11	0.12	0.12
D04	0.06	0.10	0.15	0.17
E03	0.07	0.10	0.14	0.14
G01	0.08	0.11	0.17	0.16
H03	0.08	0.09	0.18	0.14
N04	0.08	0.10	0.14	0.13
P02	0.07	0.08	0.15	0.13
Q01R	0.06	0.11	0.20	0.10

* Although two decimal places are quoted, none of the determinations has this degree of precision nor of accuracy. The data are quoted to two figures just as they are estimated at each location. They should all be regarded as about 0.1 microgray.

TABLE 4.07A 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

SEDIMENT Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (45)	7.6E+00 (4.9E+00-1.4E+01)	*		*	*
Ce-141 (45)	1.9E+00 (1.1E+00-3.6E+00)	*		*	*
Cr-51 (45)	9.2E+00 (5.4E+00-1.9E+01)	*		*	*
I-131 (45)	1.5E+00 (7.6E-01-3.0E+00)	*		*	*
Be-7 (45)	9.8E+00 (6.6E+00-2.2E+01)	4.4E+01 (21/ 41) (1.6E+01-1.8E+02)	D04	7.2E+01 (5/ 5) (1.7E+01-1.8E+02)	2.8E+01 (4/ 4) (1.9E+01-3.8E+01)
Ru-103 (45)	1.1E+00 (6.9E-01-2.4E+00)	3.3E+00 (1/ 41) (3.3E+00-3.3E+00)	D01	3.3E+00 (1/ 5) (3.3E+00-3.3E+00)	*
Ba-140 (45)	5.0E+00 (2.5E+00-1.1E+01)	*		*	*
Cs-134 (45)	1.0E+00 (5.4E-01-2.2E+00)	*		*	*
Ru-106 (45)	9.8E+00 (6.3E+00-2.0E+01)	*		*	*
Cs-137 (45)	1.3E+00 (5.3E-01-2.4E+00)	4.3E+00 (18/ 41) (2.1E+00-1.6E+01)	D04	6.1E+00 (5/ 5) (2.4E+00-1.6E+01)	2.4E+00 (2/ 4) (2.0E+00-2.8E+00)
Zr-95 (45)	2.1E+00 (1.2E+00-4.1E+00)	*		*	*
Nb-95 (45)	1.1E+00 (6.1E-01-2.1E+00)	*		*	*
Co-58 (45)	1.1E+00 (6.0E-01-1.8E+00)	*		*	*
Mn-54 (45)	1.1E+00 (6.7E-01-2.2E+00)	*		*	*

TABLE 4.07A (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

SEDIMENT Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (45)	1.4E+00 (8.8E-01-3.2E+00)	*		*	*
Ac-228 (45)	4.2E+00 (2.2E+00-8.1E+00)	2.3E+01 (41/ 41) (1.1E+01-4.4E+01)	D01	3.7E+01 (5/ 5) (3.2E+01-4.4E+01)	3.0E+01 (4/ 4) (2.7E+01-3.6E+01)
Fe-59 (45)	2.8E+00 (1.8E+00-4.4E+00)	*		*	*
Zn-65 (45)	2.9E+00 (1.8E+00-5.5E+00)	*		*	*
Co-60 (45)	1.3E+00 (7.7E-01-2.6E+00)	*		*	*
K-40 (45)	1.1E+01 (6.9E+00-1.8E+01)	6.1E+02 (41/ 41) (4.5E+02-9.1E+02)	D01	7.0E+02 (5/ 5) (6.3E+02-7.5E+02)	5.4E+02 (4/ 4) (4.8E+02-6.1E+02)
La-140 (45)	1.4E+00 (3.8E-01-2.7E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.07B

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
1978 to 1986

Cs-137 IN SEDIMENTS (Bq/kg). GAMMA SPECTROMETRIC ANALYSIS

LOCATION	B01	C01	D01	D04	E03	G01	H03	N04	P02	Q01R
PERIOD	*	+	+	+	*	*	*	*	*	+
1978	<1.3	3.6	7.8	—	<5.0	<2.1	<1.5	<2.1	<1.6	7.0
1979 1	<0.9	8.2	8.6	5.9	<2.2	<2.3	<1.5	<2.2	<1.5	9.2
1979 2	<0.8	3.9	4.8	5.7	<1.0	3.7	<1.9	<1.5	<1.0	3.8
1979 3	<0.8	4.2	3.8	11.5	<0.7	<2.1	1.9	<1.7	<1.4	3.4
1979 4	<1.2	3.2	4.1	4.4	<1.1	<2.3	<1.0	2.9	<1.0	5.3
1980 1	<2.1	3.5	3.3	8.3	<1.7	<3.0	<1.1	<1.6	<1.4	9.0
1980 2	<1.5	2.4	5.7	14.0	<1.3	1.4	<0.9	<1.2	<2.0	6.6
1980 3	<1.1	2.6	5.3	14.5	<1.2	<2.8	<1.1	<1.0	<4.2	4.8
1980 4	<1.4	3.4	2.6	8.5	<0.7	<2.8	<1.7	<0.9	<1.5	1.9
1981 1	<0.7	2.3	3.7	7.6	<1.3	1.3	<1.1	2.2	<0.8	5.3
1981 2	1.5	2.5	3.5	10.9	<0.8	1.0	<0.9	<1.6	<1.4	5.6
1981 3	<1.1	1.8	4.4	8.5	<0.9	<0.9	<1.5	<1.9	<1.1	4.7
1981 4	<1.7	3.2	4.1	12.7	<1.0	<2.1	<1.6	<2.7	<1.6	5.5
1982 1	<1.0	1.9	3.9	6.3	<1.1	1.7	<1.6	<2.2	<1.0	4.7
1982 2	<0.9	3.3	4.5	8.2	<1.7	<2.4	<1.2	<1.7	<1.9	5.7
1982 3	<1.3	3.1	10.0	6.3	<2.3	<5.0	<1.0	3.0	<4.1	5.6
1982 4	<0.8	5.6	4.7	8.2	<1.3	<2.4	<2.3	2.4	<1.4	7.3
1983 1	<1.5	<2.1	5.1	6.3	<1.0	<5.5	<2.4	<3.4	<1.9	<6.8
1983 2	<1.7	3.3	<4.7	6.0	<1.2	<3.5	<2.9	<3.9	<1.2	4.6
1983 3	<1.4	<1.5	3.7	6.4	<1.3	<6.9	<2.6	<1.9	<1.1	<5.6
1983 4	<1.5	2.7	<3.8	4.5	<1.1	<2.0	<1.1	<2.0	<1.7	<1.6
1984 1	<1.9	<3.4	4.3	5.3	<2.1	<8.6	<1.7	<2.5	<1.6	4.0
1984 2	<1.0	<2.7	2.3	6.5	<1.4	<1.0	<0.9	<1.7	<1.0	3.1
1984 3	<1.2	<2.6	3.5	5.0	<1.6	<1.5	<0.9	<0.9	<1.6	4.9
1984 4	<1.9	<2.2	3.5	11.9	<1.7	<2.2	<2.6	<2.7	<3.9	3.2
1985 1	<1.1	<1.8	3.0	5.3	<0.6	<1.9	<1.6	<1.4	<0.9	<2.1
1985 2	<1.3	<1.3	<4.0	4.4	<1.2	<1.5	<1.5	<2.1	<1.5	1.8
1985 3	<0.8	<1.1	3.7	9.7	<1.8	<0.9	<1.6	<1.0	<2.0	1.8
1985 4	<1.4	2.4	4.3	3.5	<1.2	<2.1	<1.2	<1.2	<1.3	<1.4
1986 1	<0.8	2.1	4.9	4.6	<1.3	<0.8	<1.2	4.2	<1.3	2.8
1986 2	<0.8	2.9	7.3	2.4	<1.1	<2.4	<1.9	2.7	<1.0	2.0
1986 3	<1.3	2.6	<3.9	4.6	<1.3	<1.9	<1.3	<1.7	<1.4	<3.4
1986 4	<1.9	3.0	4.1	16.0	<1.4	<1.9	<0.8	3.6	<0.9	<2.9

< means not detected. * Coarse grained sediment. + Fine grained sediment.

TABLE 4.08 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

WELL WATER Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Gross-A (20)	8.1E-02 (2.5E-02-4.6E-01)	8.0E-02 (8/ 18) (2.7E-02-1.3E-01)	N02	1.3E-01 (2/ 2) (1.2E-01-1.3E-01)	*
Gross-B (20)	2.4E-02 (2.0E-02-3.4E-02)	1.0E-01 (18/ 18) (3.9E-02-2.3E-01)	H04	2.0E-01 (2/ 2) (1.8E-01-2.1E-01)	4.0E-02 (2/ 2) (3.7E-02-4.4E-02)
H-3 (20)	1.9E+01 (1.8E+01-2.1E+01)	1.9E+01 (1/ 18) (1.9E+01-1.9E+01)	N03	1.9E+01 (1/ 2) (1.9E+01-1.9E+01)	*
Ce-144 (20)	1.2E+00 (7.9E-01-2.3E+00)	*		*	*
Ce-141 (20)	3.0E-01 (2.4E-01-5.4E-01)	*		*	*
Cr-51 (20)	1.4E+00 (1.0E+00-2.2E+00)	*		*	*
I-131 (20)	2.3E-01 (1.6E-01-3.4E-01)	*		*	*
Be-7 (20)	1.2E+00 (9.1E-01-2.0E+00)	*		*	*
Ru-103 (20)	1.5E-01 (1.2E-01-2.0E-01)	*		*	*
Ba-140 (20)	7.0E-01 (4.9E-01-1.0E+00)	*		*	*
Cs-134 (20)	1.4E-01 (1.0E-01-2.0E-01)	*		*	*
Ru-106 (20)	1.2E+00 (9.6E-01-1.8E+00)	*		*	*
Cs-137 (20)	1.4E-01 (9.9E-02-2.5E-01)	*		*	*
Zr-95 (20)	2.4E-01 (1.1E-01-3.8E-01)	*		*	*

TABLE 4.08 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

WELL WATER Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Nb-95 (20)	1.4E-01 (8.9E-02-2.3E-01)	*		*	*
Co-58 (20)	1.3E-01 (9.5E-02-2.0E-01)	*		*	*
Mn-54 (20)	1.2E-01 (7.9E-02-2.2E-01)	*		*	*
Ag-110m (20)	1.8E-01 (6.4E-02-3.6E-01)	*		*	*
Ac-228 (20)	4.9E-01 (2.9E-01-8.7E-01)	*		*	*
Fe-59 (20)	3.0E-01 (1.9E-01-5.2E-01)	*		*	*
Zn-65 (20)	3.0E-01 (2.0E-01-4.3E-01)	*		*	*
Co-60 (20)	1.5E-01 (9.4E-02-2.2E-01)	*		*	*
K-40 (20)	2.1E+00 (7.7E-01-3.0E+00)	3.2E+00 (1/ 18) (3.2E+00-3.2E+00)	E02	3.2E+00 (1/ 2) (3.2E+00-3.2E+00)	*
La-140 (20)	2.2E-01 (1.1E-01-4.0E-01)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.09 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

BORE HOLE WATER Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (12)	2.1E+01 (1.9E+01-2.6E+01)	5.5E+01 (11/ 12) (3.3E+01-7.4E+01)	I00A	6.7E+01 (4/ 4) (5.1E+01-7.4E+01)	*
Ce-144 (12)	1.1E+00 (1.0E+00-1.3E+00)	*		*	*
Ce-141 (12)	2.5E-01 (2.2E-01-2.8E-01)	*		*	*
Cr-51 (12)	1.2E+00 (1.0E+00-1.4E+00)	*		*	*
I-131 (12)	1.9E-01 (1.6E-01-2.3E-01)	*		*	*
Be-7 (12)	1.2E+00 (8.1E-01-1.5E+00)	*		*	*
Ru-103 (12)	1.4E-01 (7.3E-02-1.7E-01)	*		*	*
Ba-140 (12)	5.5E-01 (4.4E-01-7.1E-01)	*		*	*
Cs-134 (12)	1.3E-01 (6.1E-02-1.7E-01)	*		*	*
Ru-106 (12)	1.1E+00 (8.2E-01-1.5E+00)	*		*	*
Cs-137 (12)	1.4E-01 (8.8E-02-1.7E-01)	*		*	*
Zr-95 (12)	2.3E-01 (1.1E-01-3.1E-01)	*		*	*
Nb-95 (12)	1.3E-01 (6.2E-02-1.6E-01)	*		*	*
Co-58 (12)	1.3E-01 (6.6E-02-1.5E-01)	*		*	*

TABLE 4.09 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

BORE HOLE WATER Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (12)	1.3E-01 (1.1E-01-1.5E-01)	*		*	*
Ag-110m (12)	1.6E-01 (9.0E-02-2.1E-01)	*		*	*
Ac-228 (12)	4.7E-01 (3.7E-01-6.3E-01)	*		*	*
Fe-59 (12)	2.6E-01 (2.1E-01-3.7E-01)	*		*	*
Zn-65 (12)	2.8E-01 (2.3E-01-3.2E-01)	*		*	*
Co-60 (12)	1.4E-01 (9.4E-02-1.9E-01)	*		*	*
K-40 (12)	2.2E+00 (1.5E+00-2.7E+00)	*		*	*
La-140 (12)	1.6E-01 (9.0E-02-2.6E-01)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.10 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

PARSHALL FLUME, (SRMMF) Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Gross-A (2)	1.4E-02 (1.3E-02-1.5E-02)	7.0E-02 (2/ 2) (5.8E-02-8.1E-02)	I01	7.0E-02 (2/ 2) (5.8E-02-8.1E-02)	*
Gross-B (2)	2.2E-02 (2.2E-02-2.2E-02)	3.0E-01 (2/ 2) (2.0E-01-3.9E-01)	I01	3.0E-01 (2/ 2) (2.0E-01-3.9E-01)	*
H-3 (57)	1.9E+01 (1.6E+01-2.3E+01)	1.5E+02 (56/ 57) (1.9E+01-3.9E+02)	I01	1.5E+02 (56/ 57) (1.9E+01-3.9E+02)	*
Ce-144 (57)	1.3E+00 (8.6E-01-3.2E+00)	*		*	*
Ce-141 (57)	3.4E-01 (2.0E-01-8.2E-01)	*		*	*
Cr-51 (57)	1.8E+00 (9.0E-01-4.2E+00)	*		*	*
I-131 (57)	4.1E-01 (1.2E-01-8.2E-01)	*		*	*
Be-7 (57)	1.7E+00 (7.0E-01-4.7E+00)	2.7E+00 (1/ 57) (2.7E+00-2.7E+00)	I01	2.7E+00 (1/ 57) (2.7E+00-2.7E+00)	*
Ru-103 (57)	2.0E-01 (9.0E-02-4.8E-01)	*		*	*
Ba-140 (57)	1.1E+00 (3.5E-01-2.8E+00)	*		*	*
Cs-134 (57)	1.7E-01 (8.0E-02-4.5E-01)	*		*	*
Ru-106 (57)	1.6E+00 (7.4E-01-5.7E+00)	*		*	*
Cs-137 (57)	1.9E-01 (8.6E-02-6.6E-01)	*		*	*
Zr-95 (57)	3.4E-01 (1.5E-01-9.7E-01)	*		*	*

TABLE 4.10 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

PARSHALL FLUME, (SW9MF) Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Nb-95 (57)	1.7E-01 (7.2E-02-4.0E-01)	1.1E+00 (1/ 57) (1.1E+00-1.1E+00)	I01	1.1E+00 (1/ 57) (1.1E+00-1.1E+00)	*
Co-58 (57)	1.8E-01 (7.5E-02-6.0E-01)	*		*	*
Mn-54 (57)	1.7E-01 (7.7E-02-5.9E-01)	*		*	*
Ag-110m (57)	2.3E-01 (6.5E-02-6.7E-01)	*		*	*
Ac-228 (57)	6.4E-01 (1.7E-01-1.6E+00)	*		*	*
Fe-59 (57)	4.1E-01 (1.3E-01-1.4E+00)	*		*	*
Zn-65 (57)	3.8E-01 (1.2E-01-1.2E+00)	*		*	*
Co-60 (57)	2.2E-01 (6.7E-02-6.3E-01)	4.7E+00 (2/ 57) (8.5E-01-8.6E+00)	I01	4.7E+00 (2/ 57) (8.5E-01-8.6E+00)	*
K-40 (57)	2.8E+00 (1.2E+00-8.4E+00)	*		*	*
La-140 (57)	3.4E-01 (8.6E-02-1.0E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.11 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

LAGOON WATER Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (38)	2.8E+01 (1.5E+01-1.2E+02)	4.2E+03 (38/ 38) (4.0E+01-5.9E+04)	K03W	6.8E+03 (12/ 12) (7.0E+02-5.9E+04)	*
Gd-153 (38)	8.5E-01 (6.4E-01-1.2E+00)	*		*	*
Ce-144 (38)	1.8E+00 (1.5E+00-2.6E+00)	*		*	*
Mo-99 (38)	9.5E-01 (3.4E-01-2.3E+00)	*		*	*
Ce-141 (38)	4.5E-01 (3.4E-01-7.7E-01)	*		*	*
Np-239 (38)	7.8E+00 (2.0E+00-2.2E+01)	*		*	*
Cr-51 (38)	2.5E+00 (1.9E+00-4.1E+00)	*		*	*
Gd-159 (38)	6.9E+02 (1.5E+01-3.7E+03)	*		*	*
I-131 (38)	4.2E-01 (2.8E-01-7.4E-01)	*		*	*
Ru-103 (38)	2.8E-01 (1.4E-01-4.4E-01)	*		*	*
Ba-140 (38)	1.2E+00 (8.4E-01-2.2E+00)	*		*	*
Cs-134 (38)	2.6E-01 (1.7E-01-4.2E-01)	*		*	*
Ru-106 (38)	2.4E+00 (1.4E+00-4.1E+00)	*		*	*
Cs-137 (38)	2.8E-01 (1.5E-01-4.2E-01)	*		*	*

TABLE 4.11 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

LAGOON WATER Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Zr-95 (38)	4.6E-01 (3.1E-01-6.5E-01)	*		*	*
Nb-95 (38)	2.7E-01 (1.6E-01-4.3E-01)	*		*	*
Co-58 (38)	2.6E-01 (1.0E-01-4.2E-01)	*		*	*
Mn-54 (38)	2.6E-01 (1.0E-01-3.9E-01)	*		*	*
Ag-110m (38)	3.4E-01 (2.0E-01-5.9E-01)	*		*	*
Sc-46 (38)	2.8E-01 (1.7E-01-4.3E-01)	*		*	*
Fe-59 (38)	5.8E-01 (2.4E-01-8.6E-01)	*		*	*
Zn-65 (38)	6.0E-01 (4.0E-01-9.6E-01)	*		*	*
Co-60 (38)	3.1E-01 (1.5E-01-4.5E-01)	*		*	*
La-140 (38)	4.5E-01 (2.2E-01-8.4E-01)	*		*	*
Sb-124 (38)	6.3E-01 (3.8E-01-1.1E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.12 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

LAGOON SLUDGE Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (7)	2.9E+01 (1.9E+01-4.5E+01)	5.6E+03 (7/ 7) (1.3E+03-8.7E+03)	K03W	7.2E+03 (1/ 1) (7.2E+03-7.2E+03)	*
Gd-153 (11)	7.2E-01 (5.2E-01-1.0E+00)	*		*	*
Ce-144 (11)	1.5E+00 (9.6E-01-2.2E+00)	*		*	*
Mo-99 (11)	4.7E+00 (1.6E-01-2.6E+01)	*		*	*
Ce-141 (11)	3.7E-01 (2.4E-01-5.9E-01)	*		*	*
Np-239 (11)	6.8E+01 (1.0E+00-3.7E+02)	*		*	*
Cr-51 (11)	1.9E+00 (1.0E+00-4.2E+00)	*		*	*
Gd-159 (11)	4.8E+06 (2.7E+00-2.8E+07)	*		*	*
I-131 (11)	4.1E-01 (1.4E-01-1.3E+00)	*		*	*
Ru-103 (11)	2.1E-01 (1.0E-01-4.3E-01)	4.2E-01 (1/ 11) (4.2E-01-4.2E-01)	K03E	4.2E-01 (1/ 8) (4.2E-01-4.2E-01)	*
Ba-140 (11)	1.1E+00 (4.3E-01-3.3E+00)	*		*	*
Cs-134 (11)	2.1E-01 (1.1E-01-3.4E-01)	*		*	*
Ru-106 (11)	1.8E+00 (9.7E-01-2.7E+00)	*		*	*
Cs-137 (11)	2.2E-01 (1.2E-01-3.8E-01)	6.3E-01 (1/ 11) (6.3E-01-6.3E-01)	K03E	6.3E-01 (1/ 8) (6.3E-01-6.3E-01)	*

TABLE 4.12 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

LAGOON SLULGE Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Zr-95 (11)	3.8E-01 (1.8E-01-6.3E-01)	*		*	*
Nb-95 (11)	2.1E-01 (1.0E-01-3.9E-01)	5.7E-01 (1/ 11) (5.7E-01-5.7E-01)	K03E	5.7E-01 (1/ 8) (5.7E-01-5.7E-01)	*
Co-58 (11)	2.0E-01 (9.4E-02-3.3E-01)	*		*	*
Mn-54 (11)	2.0E-01 (1.1E-01-3.0E-01)	*		*	*
Ag-110m (11)	2.7E-01 (1.4E-01-4.1E-01)	*		*	*
Sc-46 (11)	1.9E-01 (1.0E-01-3.2E-01)	*		*	*
Fe-59 (11)	4.3E-01 (1.7E-01-7.3E-01)	*		*	*
Zn-65 (11)	4.5E-01 (2.2E-01-8.4E-01)	*		*	*
Co-60 (11)	2.3E-01 (1.3E-01-4.2E-01)	*		*	*
La-140 (11)	3.7E-01 (1.4E-01-8.5E-01)	*		*	*
Sb-124 (11)	5.6E-01 (1.7E-01-1.2E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.13 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

SEA WATER Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (18)	1.9E+01 (1.9E+01-2.1E+01)	2.2E+01 (1/ 14) (2.2E+01-2.2E+01)	E03	2.2E+01 (1/ 4) (2.2E+01-2.2E+01)	*
Ce-144 (18)	1.0E+00 (9.3E-01-1.2E+00)	*		*	*
Ce-141 (18)	2.3E-01 (2.1E-01-2.6E-01)	*		*	*
Cr-51 (18)	1.1E+00 (8.2E-01-1.3E+00)	*		*	*
I-131 (18)	1.5E-01 (1.0E-01-2.2E-01)	*		*	*
Be-7 (18)	1.0E+00 (7.5E-01-1.4E+00)	*		*	*
Ru-103 (18)	1.3E-01 (7.8E-02-1.6E-01)	*		*	*
Ba-140 (18)	5.2E-01 (3.3E-01-7.1E-01)	*		*	*
Cs-134 (18)	1.2E-01 (9.4E-02-1.6E-01)	*		*	*
Ru-106 (18)	1.2E+00 (7.3E-01-1.5E+00)	*		*	*
Cs-137 (18)	1.4E-01 (8.8E-02-1.8E-01)	*		*	*
Zr-95 (18)	2.3E-01 (1.1E-01-2.8E-01)	*		*	*
Nb-95 (18)	1.3E-01 (6.1E-02-1.7E-01)	*		*	*
Co-58 (18)	1.2E-01 (6.4E-02-1.6E-01)	*		*	*

TABLE 4.13 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

SEA WATER Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (18)	1.2E-01 (9.1E-02-2.0E-01)	*		*	*
Ag-110m (18)	1.7E-01 (1.1E-01-2.0E-01)	*		*	*
Ac-228 (18)	4.3E-01 (2.9E-01-5.8E-01)	*		*	*
Fe-59 (18)	2.9E-01 (1.5E-01-3.6E-01)	*		*	*
Zn-65 (18)	3.3E-01 (2.7E-01-4.4E-01)	*		*	*
Co-60 (18)	1.6E-01 (1.1E-01-2.2E-01)	*		*	*
K-40 (18)	1.4E+00 (1.0E+00-2.4E+00)	1.2E+01 (14/ 14) (9.3E+00-1.4E+01)	H03	1.2E+01 (5/ 5) (1.0E+01-1.4E+01)	9.6E+00 (4/ 4) (7.5E+00-1.1E+01)
La-140 (18)	1.8E-01 (8.8E-02-2.5E-01)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.14 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

MILK Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (19)	2.0E+01 (1.8E+01-2.3E+01)	1.9E+01 (1/ 6) (1.9E+01-1.9E+01)	A04	1.9E+01 (1/ 5) (1.9E+01-1.9E+01)	2.7E+01 (1/ 13) (2.7E+01-2.7E+01)
Ce-144 (20)	3.6E-01 (3.3E-01-4.0E-01)	*		*	*
Ce-141 (20)	8.2E-02 (7.7E-02-9.3E-02)	*		*	*
Cr-51 (20)	4.0E-01 (3.8E-01-4.7E-01)	*		*	*
I-131 (20)	5.6E-02 (4.9E-02-7.3E-02)	*		*	2.7E-01 (2/ 14) (1.6E-01-3.8E-01)
Be-7 (20)	3.9E-01 (3.7E-01-4.5E-01)	*		*	*
Ru-103 (20)	4.6E-02 (4.2E-02-5.2E-02)	*		*	*
Ba-140 (20)	1.9E-01 (1.6E-01-2.3E-01)	*		*	*
Cs-134 (20)	4.5E-02 (3.6E-02-5.4E-02)	7.3E-02 (1/ 6) (7.3E-02-7.3E-02)	A04	7.3E-02 (1/ 5) (7.3E-02-7.3E-02)	1.4E-01 (3/ 14) (6.6E-02-2.5E-01)
Ru-106 (20)	4.3E-01 (3.9E-01-4.8E-01)	*		*	*
Cs-137 (20)	5.4E-02 (2.4E-02-7.3E-02)	1.6E-01 (3/ 6) (1.2E-01-2.2E-01)	A04	1.6E-01 (3/ 5) (1.2E-01-2.2E-01)	2.0E-01 (8/ 14) (8.5E-02-4.7E-01)
Zr-95 (20)	8.2E-02 (7.1E-02-9.4E-02)	*		*	*
Nb-95 (20)	4.7E-02 (4.3E-02-5.3E-02)	*		*	*
Co-58 (20)	4.9E-02 (4.3E-02-5.4E-02)	*		*	*

TABLE 4.14 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

MILK Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (20)	4.8E-02 (4.4E-02-5.6E-02)	*		*	*
Ag-110m (20)	6.4E-02 (5.6E-02-7.4E-02)	*		*	*
Ac-228 (20)	1.9E-01 (1.7E-01-2.1E-01)	*		*	*
Fe-59 (20)	1.2E-01 (1.1E-01-1.4E-01)	*		*	*
Zn-65 (20)	1.3E-01 (1.1E-01-1.5E-01)	*		*	*
Co-60 (20)	5.9E-02 (5.4E-02-6.8E-02)	*		*	*
K-40 (20)	5.6E-01 (4.2E-01-6.5E-01)	5.2E+01 (6/ 6) (4.8E+01-5.6E+01)	X10	5.6E+01 (1/ 1) (5.6E+01-5.6E+01)	5.1E+01 (14/ 14) (4.9E+01-5.5E+01)
La-140 (20)	5.4E-02 (3.9E-02-7.3E-02)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.15 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

CLAMS (EDIBLE, RAW MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (11)	7.6E+00 (4.9E+00-1.0E+01)	*		*	*
Ce-141 (11)	1.8E+00 (1.1E+00-2.2E+00)	*		*	*
Cr-51 (11)	1.0E+01 (5.4E+00-1.4E+01)	*		*	*
I-131 (11)	1.5E+00 (9.9E-01-2.3E+00)	*		*	*
Be-7 (11)	1.0E+01 (5.2E+00-1.5E+01)	*		*	*
Ru-103 (11)	1.2E+00 (6.8E-01-1.6E+00)	*		*	*
Ba-140 (11)	5.3E+00 (2.9E+00-7.4E+00)	*		*	*
Cs-134 (11)	1.2E+00 (6.9E-01-2.1E+00)	*		*	*
Ru-106 (11)	1.0E+01 (7.7E+00-1.5E+01)	*		*	*
Cs-137 (11)	1.3E+00 (7.0E-01-2.1E+00)	*		*	*
Zr-95 (11)	1.8E+00 (1.0E+00-2.5E+00)	*		*	*
Nb-95 (11)	1.1E+00 (4.4E-01-1.6E+00)	*		*	*
Co-58 (11)	1.1E+00 (7.0E-01-1.3E+00)	*		*	*
Mn-54 (11)	1.1E+00 (6.1E-01-1.6E+00)	*		*	*

TABLE 4.15 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

CLAMS (EDIBLE, RAW MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (11)	1.7E+00 (9.8E-01-2.2E+00)	*		*	*
Ac-228 (11)	5.2E+00 (2.4E+00-7.6E+00)	1.2E+01 (2/ 10) (1.1E+01-1.3E+01)	C01	1.2E+01 (2/ 2) (1.1E+01-1.3E+01)	*
Fe-59 (11)	2.6E+00 (1.3E+00-3.4E+00)	*		*	*
Zn-65 (11)	2.8E+00 (1.0E+00-5.3E+00)	*		*	*
Co-60 (11)	1.4E+00 (5.6E-01-2.6E+00)	*		*	*
K-40 (11)	1.1E+01 (6.3E+00-1.7E+01)	9.5E+01 (10/ 10) (5.3E+01-1.5E+02)	D04	1.1E+02 (3/ 3) (8.2E+01-1.5E+02)	1.1E+02 (1/ 1) (1.1E+02-1.1E+02)
La-140 (11)	1.7E+00 (9.6E-01-2.6E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.16 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

CRAB (EDIBLE, COOKED MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (1)	2.1E+01 (2.1E+01-2.1E+01)	*		*	*
Ce-141 (1)	5.9E+00 (5.9E+00-5.9E+00)	*		*	*
Cr-51 (1)	3.2E+01 (3.2E+01-3.2E+01)	*		*	*
I-131 (1)	7.2E+00 (7.2E+00-7.2E+00)	*		*	*
Be-7 (1)	2.9E+01 (2.9E+01-2.9E+01)	*		*	*
Ru-103 (1)	3.9E+00 (3.9E+00-3.9E+00)	*		*	*
Ba-140 (1)	2.2E+01 (2.2E+01-2.2E+01)	*		*	*
Cs-134 (1)	3.1E+00 (3.1E+00-3.1E+00)	*		*	*
Ru-106 (1)	3.1E+01 (3.1E+01-3.1E+01)	*		*	*
Cs-137 (1)	3.9E+00 (3.9E+00-3.9E+00)	*		*	*
Zr-95 (1)	5.8E+00 (5.8E+00-5.8E+00)	*		*	*
Nb-95 (1)	3.2E+00 (3.2E+00-3.2E+00)	*		*	*
Co-58 (1)	4.2E+00 (4.2E+00-4.2E+00)	*		*	*
Mn-54 (1)	4.5E+00 (4.5E+00-4.5E+00)	*		*	*

TABLE 4.16 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

CRAB (EDIBLE, COOKED MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (1)	5.2E+00 (5.2E+00-5.2E+00)	*		*	*
Ac-228 (1)	9.6E+00 (9.6E+00-9.6E+00)	*		*	*
Fe-59 (1)	7.6E+00 (7.6E+00-7.6E+00)	*		*	*
Zn-65 (1)	4.8E+00 (4.8E+00-4.8E+00)	*		*	*
Co-60 (1)	3.4E+00 (3.4E+00-3.4E+00)	*		*	*
K-40 (1)	0.0E+00 (0.0E+00-0.0E+00)	1.9E+02 (1/ 1) (1.9E+02-1.9E+02)	H02	1.9E+02 (1/ 1) (1.9E+02-1.9E+02)	*
La-140 (1)	8.2E+00 (8.2E+00-8.2E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.17 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

DULSE (WET MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (8)	7.6E+00 (2.6E+00-1.5E+01)	*		*	*
Ce-141 (8)	1.7E+00 (4.9E-01-3.2E+00)	*		*	*
Cr-51 (8)	1.0E+01 (2.8E+00-1.7E+01)	*		*	*
I-131 (8)	1.6E+00 (3.2E-01-2.8E+00)	*		*	*
Be-7 (8)	1.2E+01 (2.7E+00-2.0E+01)	7.3E+00 (1/ 8) (7.3E+00-7.3E+00)	E03	7.3E+00 (1/ 4) (7.3E+00-7.3E+00)	*
Ru-103 (8)	1.3E+00 (3.6E-01-2.7E+00)	*		*	*
Ba-140 (8)	5.4E+00 (1.1E+00-8.9E+00)	*		*	*
Cs-134 (8)	1.2E+00 (3.4E-01-2.6E+00)	*		*	*
Ru-106 (8)	1.3E+01 (3.6E+00-2.4E+01)	*		*	*
Cs-137 (8)	1.5E+00 (4.3E-01-2.9E+00)	*		*	*
Zr-95 (8)	2.0E+00 (6.5E-01-4.3E+00)	*		*	*
Nb-95 (8)	1.2E+00 (4.0E-01-1.9E+00)	*		*	*
Co-58 (8)	1.3E+00 (3.8E-01-2.7E+00)	*		*	*
Mn-54 (8)	1.1E+00 (4.1E-01-2.2E+00)	*		*	*

TABLE 4.17 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

DULSE (WET MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (8)	1.8E+00 (4.6E-01-3.1E+00)	*		*	*
Ac-228 (8)	4.6E+00 (1.4E+00-1.1E+01)	*		*	*
Fe-59 (8)	3.4E+00 (1.1E+00-5.0E+00)	*		*	*
Zn-65 (8)	3.0E+00 (1.3E+00-4.6E+00)	*		*	*
Co-60 (8)	1.6E+00 (4.0E-01-2.4E+00)	*		*	*
K-40 (8)	1.3E+01 (4.6E+00-2.3E+01)	3.6E+02 (8/ 8) (2.3E+02-5.4E+02)	E03	3.7E+02 (4/ 4) (3.4E+02-4.0E+02)	*
La-140 (8)	1.4E+00 (2.6E-01-2.0E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.18 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

FISH, VARIOUS, EDIBLE RAW MASS Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (14)	5.2E+00 (3.8E+00-6.7E+00)	*		*	*
Ce-141 (14)	1.5E+00 (9.4E-01-2.8E+00)	*		*	*
Cr-51 (14)	8.9E+00 (4.9E+00-2.0E+01)	*		*	*
I-131 (14)	2.7E+00 (1.0E+00-1.1E+01)	*		*	*
Be-7 (14)	8.2E+00 (4.9E+00-1.4E+01)	*		*	*
Ru-103 (14)	1.0E+00 (5.8E-01-2.1E+00)	*		*	*
Ba-140 (14)	6.0E+00 (2.6E+00-1.8E+01)	*		*	*
Cs-134 (14)	8.5E-01 (5.4E-01-1.2E+00)	*		*	*
Ru-106 (14)	7.8E+00 (5.3E+00-1.1E+01)	*		*	*
Cs-137 (14)	1.0E+00 (6.0E-01-1.6E+00)	*		*	*
Zr-95 (14)	1.6E+00 (1.0E+00-2.8E+00)	*		*	*
Nb-95 (14)	9.5E-01 (5.4E-01-1.4E+00)	*		*	*
Co-58 (14)	8.8E-01 (5.5E-01-1.3E+00)	*		*	*
Mn-54 (14)	8.3E-01 (4.0E-01-1.3E+00)	*		*	*

TABLE 4.18 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

FISH, VARIOUS, EDIBLE RAW MASS Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (14)	1.1E+00 (7.0E-01-1.8E+00)	*		*	*
Ac-228 (14)	3.1E+00 (1.4E+00-4.1E+00)	*		*	*
Fe-59 (14)	2.1E+00 (5.4E-01-3.8E+00)	*		*	*
Zn-65 (14)	2.3E+00 (1.6E+00-3.0E+00)	*		*	*
Co-60 (14)	9.9E-01 (4.6E-01-1.4E+00)	*		*	*
K-40 (14)	8.7E+00 (4.8E+00-1.4E+01)	1.4E+02 (12/ 12) (8.9E+01-1.8E+02)	H02	1.6E+02 (1/ 1) (1.6E+02-1.6E+02)	1.4E+02 (2/ 2) (1.4E+02-1.5E+02)
La-140 (14)	1.5E+00 (5.5E-01-3.7E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.19 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

LOBSTER (EDIBLE, COOKED MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (7)	6.3E+00 (3.6E+00-1.2E+01)	*		*	*
Ce-141 (7)	1.7E+00 (8.9E-01-3.7E+00)	*		*	*
Cr-51 (7)	9.7E+00 (5.8E+00-2.1E+01)	*		*	*
I-131 (7)	2.4E+00 (8.4E-01-7.8E+00)	*		*	*
Be-7 (7)	8.9E+00 (4.8E+00-1.8E+01)	*		*	*
Ru-103 (7)	1.1E+00 (5.5E-01-2.4E+00)	*		*	*
Ba-140 (7)	6.5E+00 (2.6E+00-2.1E+01)	*		*	*
Cs-134 (7)	1.0E+00 (5.9E-01-2.2E+00)	*		*	*
Ru-106 (7)	1.1E+01 (5.1E+00-2.0E+01)	*		*	*
Cs-137 (7)	1.3E+00 (6.6E-01-2.8E+00)	*		*	*
Zr-95 (7)	1.9E+00 (1.0E+00-4.0E+00)	*		*	*
Nb-95 (7)	1.1E+00 (6.2E-01-2.1E+00)	*		*	*
Co-58 (7)	1.0E+00 (3.5E-01-2.1E+00)	*		*	*
Mn-54 (7)	1.2E+00 (6.1E-01-2.7E+00)	*		*	*

TABLE 4.19 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

LOBSTER (EDIBLE, COOKED MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (7)	1.5E+00 (7.5E-01-3.3E+00)	*		*	*
Ac-228 (7)	3.9E+00 (1.5E+00-8.0E+00)	*		*	*
Fe-59 (7)	2.4E+00 (1.0E+00-5.0E+00)	*		*	*
Zn-65 (7)	2.9E+00 (1.9E+00-6.8E+00)	*		*	*
Co-60 (7)	1.2E+00 (7.5E-01-2.3E+00)	*		*	*
K-40 (7)	9.8E+00 (3.8E+00-1.7E+01)	1.1E+02 (6/ 6) (1.0E+02-1.5E+02)	H02	1.3E+02 (2/ 2) (1.0E+02-1.5E+02)	1.2E+02 (1/ 1) (1.2E+02-1.2E+02)
La-140 (7)	1.9E+00 (7.4E-01-7.1E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.20 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

PERIWINKLES (EDIBLE MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (5)	9.7E+00 (6.6E+00-1.4E+01)	*		*	*
Ce-141 (5)	2.7E+00 (1.6E+00-4.3E+00)	*		*	*
Cr-51 (5)	1.4E+01 (9.2E+00-2.5E+01)	*		*	*
I-131 (5)	2.8E+00 (1.7E+00-5.2E+00)	*		*	*
Be-7 (5)	1.3E+01 (8.2E+00-1.8E+01)	*		*	*
Ru-103 (5)	1.7E+00 (1.1E+00-2.8E+00)	*		*	*
Ba-140 (5)	8.4E+00 (4.6E+00-1.6E+01)	*		*	*
Cs-134 (5)	1.6E+00 (1.0E+00-2.4E+00)	*		*	*
Ru-106 (5)	1.3E+01 (3.4E+00-2.1E+01)	*		*	*
Cs-137 (5)	1.9E+00 (1.2E+00-3.0E+00)	*		*	*
Zr-95 (5)	2.9E+00 (1.5E+00-4.8E+00)	*		*	*
Nb-95 (5)	1.7E+00 (1.1E+00-2.4E+00)	*		*	*
Co-58 (5)	1.7E+00 (8.7E-01-2.6E+00)	*		*	*
Mn-54 (5)	1.5E+00 (9.3E-01-2.1E+00)	*		*	*

TABLE 4.20 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

PERIWINKLES (EDIBLE MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (5)	2.1E+00 (1.1E+00-3.5E+00)	*		*	*
Ac-228 (5)	6.3E+00 (3.1E+00-9.5E+00)	*		*	*
Fe-59 (5)	2.9E+00 (1.9E+00-4.2E+00)	*		*	*
Zn-65 (5)	3.8E+00 (1.8E+00-6.9E+00)	*		*	*
Co-60 (5)	2.1E+00 (9.2E-01-3.4E+00)	*		*	*
K-40 (5)	1.4E+01 (5.8E+00-2.4E+01)	1.1E+02 (5/ 5) (8.3E+01-1.6E+02)	E03	1.1E+02 (5/ 5) (8.3E+01-1.6E+02)	*
La-140 (5)	2.8E+00 (1.2E+00-6.2E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.21 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

SCALLOPS (EDIBLE, RAW MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (6)	4.6E+00 (3.0E+00-5.6E+00)	*		*	*
Ce-141 (6)	1.1E+00 (6.7E-01-1.4E+00)	*		*	*
Cr-51 (6)	6.1E+00 (3.6E+00-7.6E+00)	*		*	*
I-131 (6)	9.5E-01 (5.5E-01-1.2E+00)	*		*	*
Be-7 (6)	5.9E+00 (3.8E+00-7.6E+00)	*		*	*
Ru-103 (6)	7.6E-01 (5.3E-01-1.0E+00)	*		*	*
Ba-140 (6)	2.8E+00 (1.8E+00-4.0E+00)	*		*	*
Cs-134 (6)	6.8E-01 (5.3E-01-8.8E-01)	*		*	*
Ru-106 (6)	7.7E+00 (5.0E+00-1.0E+01)	*		*	*
Cs-137 (6)	8.8E-01 (5.8E-01-1.2E+00)	*		*	*
Zr-95 (6)	1.3E+00 (6.1E-01-1.9E+00)	*		*	*
Nb-95 (6)	7.5E-01 (3.4E-01-1.1E+00)	*		*	*
Co-58 (6)	7.5E-01 (3.6E-01-1.2E+00)	*		*	*
Mn-54 (6)	7.2E-01 (4.8E-01-9.7E-01)	*		*	*

TABLE 4.21 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

SCALLOPS (EDIBLE, RAW MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (6)	9.2E-01 (5.1E-01-1.3E+00)	*		*	*
Ac-228 (6)	2.8E+00 (1.6E+00-4.4E+00)	*		*	*
Fe-59 (6)	1.8E+00 (1.2E+00-2.3E+00)	*		*	*
Zn-65 (6)	1.8E+00 (1.2E+00-2.4E+00)	*		*	*
Co-60 (6)	1.1E+00 (4.2E-01-1.7E+00)	*		*	*
K-40 (6)	8.1E+00 (5.3E+00-1.1E+01)	1.5E+02 (4/ 4) (1.3E+02-1.7E+02)	N06	1.5E+02 (3/ 3) (1.3E+02-1.7E+02)	1.5E+02 (2/ 2) (1.3E+02-1.7E+02)
La-140 (6)	1.0E+00 (3.8E-01-1.4E+00)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.22 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

SEA PLANT (WET MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (13)	2.9E+00 (2.2E+00-4.3E+00)	*		*	*
Ce-141 (13)	6.6E-01 (5.4E-01-8.8E-01)	*		*	*
Cr-51 (13)	3.5E+00 (2.6E+00-4.8E+00)	*		*	*
I-131 (13)	5.1E-01 (3.6E-01-7.0E-01)	1.9E+00 (1/ 13) (1.9E+00-1.9E+00)	E03	1.9E+00 (1/ 4) (1.9E+00-1.9E+00)	*
Be-7 (13)	4.2E+00 (3.0E+00-7.1E+00)	1.3E+01 (5/ 13) (8.9E+00-1.8E+01)	H03	1.8E+01 (1/ 3) (1.8E+01-1.8E+01)	*
Ru-103 (13)	4.1E-01 (3.2E-01-4.9E-01)	*		*	*
Ba-140 (13)	1.7E+00 (1.1E+00-2.1E+00)	*		*	*
Cs-134 (13)	3.9E-01 (2.7E-01-6.9E-01)	*		*	*
Ru-106 (13)	3.9E+00 (2.2E+00-6.5E+00)	*		*	*
Cs-137 (13)	5.1E-01 (3.0E-01-6.8E-01)	*		*	*
Zr-95 (13)	8.3E-01 (5.4E-01-1.2E+00)	*		*	*
Nb-95 (13)	4.9E-01 (3.2E-01-7.1E-01)	*		*	*
Co-58 (13)	4.3E-01 (3.3E-01-6.1E-01)	*		*	*
Mn-54 (13)	4.3E-01 (2.7E-01-7.5E-01)	*		*	*

TABLE 4.22 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

SEA PLANT (WET MASS) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (13)	6.1E-01 (4.7E-01-7.6E-01)	*		*	*
Ac-228 (13)	2.1E+00 (1.1E+00-2.7E+00)	*		*	*
Fe-59 (13)	1.2E+00 (9.0E-01-1.9E+00)	*		*	*
Zn-65 (13)	1.3E+00 (8.8E-01-2.2E+00)	*		*	*
Co-60 (13)	5.5E-01 (4.0E-01-7.1E-01)	*		*	*
K-40 (13)	4.3E+00 (2.3E+00-6.8E+00)	2.1E+02 (13/ 13) (1.5E+02-2.8E+02)	H03	2.3E+02 (3/ 3) (1.8E+02-2.8E+02)	*
La-140 (13)	4.7E-01 (2.5E-01-7.1E-01)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.23 87-01-20

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

VEGETATION (LICHEN) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (26)	3.2E+01 (9.4E+00-7.3E+01)	*		*	*
Ce-141 (26)	7.6E+00 (1.8E+00-1.9E+01)	*		*	*
Cr-51 (26)	4.4E+01 (7.9E+00-1.0E+02)	*		*	*
I-131 (26)	7.5E+00 (1.2E+00-2.2E+01)	*		*	5.7E+01 (7/ 10) (1.5E+01-1.7E+02)
Be-7 (26)	5.0E+01 (5.9E+00-1.2E+02)	2.9E+02 (11/ 16) (5.2E+01-4.4E+02)	I00	4.4E+02 (2/ 2) (4.3E+02-4.4E+02)	2.2E+02 (10/ 10) (4.5E+01-3.4E+02)
Ru-103 (26)	5.0E+00 (1.0E+00-1.4E+01)	*		*	1.3E+01 (3/ 10) (1.0E+01-1.6E+01)
Ba-140 (26)	2.2E+01 (3.0E+00-6.5E+01)	*		*	*
Cs-134 (26)	4.9E+00 (7.3E-01-1.2E+01)	1.6E+01 (5/ 16) (9.6E+00-2.1E+01)	I00	2.1E+01 (1/ 2) (2.1E+01-2.1E+01)	1.4E+01 (2/ 10) (9.9E+00-1.7E+01)
Ru-106 (26)	4.8E+01 (8.3E+00-1.2E+02)	*		*	*
Cs-137 (26)	6.1E+00 (1.8E+00-1.7E+01)	4.7E+01 (9/ 16) (1.9E+01-6.8E+01)	K01	5.7E+01 (2/ 5) (4.6E+01-6.8E+01)	1.0E+02 (10/ 10) (3.0E+01-3.2E+02)
Zr-95 (26)	8.0E+00 (2.3E+00-2.3E+01)	*		*	*
Nb-95 (26)	4.7E+00 (9.9E-01-1.3E+01)	*		*	*
Co-58 (26)	5.0E+00 (1.5E+00-1.3E+01)	*		*	*
Mn-54 (26)	5.0E+00 (9.4E-01-1.5E+01)	*		*	*

TABLE 4.23 (Cont'd) 87-01-20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

VEGETATION (LICHEN) Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (26)	6.0E+00 (1.3E+00-1.6E+01)	*		*	*
Ac-228 (26)	1.8E+01 (5.4E+00-5.5E+01)	*		*	*
Fe-59 (26)	9.2E+00 (2.4E+00-2.4E+01)	*		*	*
Zn-65 (26)	1.1E+01 (3.3E+00-2.7E+01)	*		*	*
Co-60 (26)	5.4E+00 (1.4E+00-1.2E+01)	*		*	*
K-40 (26)	5.3E+01 (1.3E+01-1.6E+02)	2.5E+02 (12/ 16) (9.0E+01-8.9E+02)	K01	4.9E+02 (4/ 5) (2.9E+02-8.9E+02)	2.0E+02 (9/ 10) (1.2E+02-3.0E+02)
La-140 (26)	7.2E+00 (1.8E+00-1.8E+01)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).
F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 4.24A

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

Strontium-90 in GEM samples. Wet Chemical Separation

WEEK	Sr-90 Bq/Filter	WEEK	Sr-90 Bq/Filter
1	<2.2E-02	27	<3.1E-02
2	<2.2E-02	28	<1.9E-02
3	<2.3E-02	29	<2.4E-02
4	<2.6E-02	30	<1.9E-02
5	<2.3E-02	31	<1.9E-02
6	<2.4E-02	32	<2.1E-02
7	<2.2E-02	33	<2.0E-02
8	<2.3E-02	34	<1.9E-02
9	<3.8E-02	35	<2.2E-02
10	<2.6E-02	36	<2.2E-02
11	<2.7E-02	37	<1.9E-02
12	<2.5E-02	38	<1.9E-02
13	<2.2E-02	39	<1.9E-02
14	<2.2E-02	40	<1.9E-02
15	<2.4E-02	41	<2.0E-02
16	<3.1E-02	42	<2.4E-02
17	<1.9E-02	43	<2.2E-02
18	<1.9E-02	44	<2.1E-02
19	<2.3E-02	45	<2.2E-02
20	<2.6E-02	46	<2.6E-02
21	<3.0E-02	47	<1.9E-02
22	<2.9E-02	48	<1.9E-02
23	2.0E-02	49	<2.6E-02
24	<2.5E-02	50	<1.9E-02
25	<2.6E-02	51	<1.9E-02
26	<2.6E-02	52	<1.9E-02

GEM Gaseous Effluent Monitoring samples collected weekly.

52 samples were collected with starting dates in 1986. The last collected sample overlaps into 1987.

The precision of the analyses is about +- 2E-02 Bq/filter at 95% confidence.

TABLE 4.24B

Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
86-01-01 to 86-12-31

Strontium-90 in LEM samples. Wet Chemical Separation

MONTH	Sr-90
JANUARY	ϕ 2.0E-02
FEBRUARY	<3.2E-02
MARCH	3.3E-02
APRIL	<3.8E-02
MAY	5.0E-02
JUNE	<3.3E-02
JULY	2.3E-02
AUGUST	2.5E-01
SEPTEMBER	<3.3E-02
OCTOBER	2.4E-02
NOVEMBER	<2.8E-02
DECEMBER	2.8E-02

LEM Liquid Effluent Monitoring samples.

ϕ ← 1.7E-2 Bq/L at the 95% confidence level.

5.0 DISCUSSION OF ENVIRONMENTAL DATA

5.1 Airborne Particulates (filters) - Table 4.01

The only fission product radionuclides detected on air particulate samples in 1986 were from the Chernobyl nuclear accident. There were no detectable airborne particulate radionuclides that could be attributed to the operation of PLGS.

Plots of the gross alpha and gross beta data from 1976 to 1986 at Welch Cove, about 1.5 km from the PLGS stack, are presented in Figure 5.1. The baseline data show the naturally occurring levels of radioactivity in the area. The peaks on the plots correspond to fallout from various bomb tests before 1978, and from the Chinese atmospheric bomb test in October of 1980 (fallout occurred in 1981 in N.B.). Fallout from the nuclear accident at Chernobyl in April 1986 was detected in early May when it reached New Brunswick. An evaluation of the local impact of fallout from this accident and the radionuclides identified is given in Appendix 1.

5.2 Airborne Radioiodine - Table 4.02

Iodine-131 was detected in airborne radioiodine samples, including Reference location samples, over a four week interval in May and June. The I-131, along with other radionuclides was attributable to the Chernobyl accident. For the remainder of the year, all I-131 levels were below the Critical Level.

5.3 Airborne Tritium - Tables 4.03A, 4.03B and 4.03C

Tritium is the only radionuclide from PLGS seen in the Air Monitoring samples. Table 4.03A is the summary table of 1986 tritium data; Table 4.03B gives details of 1986 tritium results by location and Table 4.03C is a summary of tritium data obtained to date since this program was started in 1976.

Since tritium is now detectable in air monitoring stations close to the PLGS stack, it has become possible to calculate the annual average dispersion factors for stack emissions and compare them with the graph value at 1 km (2.2E-7 s/m^3) used in the DEL licensing document (1). Results since 1984 are presented in Table 5.1.

(1) "Derived Emission Limits for Radionuclides in Gaseous and Liquid Effluents." New Brunswick Electric Power Commission Report NBEPC-HP-76-1, 1976.

TABLE 5.1

AVERAGE ATMOSPHERIC DISPERSION FACTOR FOR EACH AIR MONITORING LOCATION (1).

Locn.	E01 Maces Bay	F01 Welch Cove	G02 Light-house	H04 Info. Centre	I01 SRWMF	K02 Pump-house	N01 Dipper Hrbr.
km from stack	4.5	1.5	1.0	0.8	1.0	0.2	3.8
Year.	Dispersion Factors: s/m³						
1984	8E-8	8E-8	2E-7	5E-7	7E-7*	5E-7	8E-8
1985	2E-8	4E-8	9E-8	3E-7	2E-7	3E-7	5E-8
1986	3E-8	5E-8	1E-7	3E-7	2E-7	5E-7	6E-8

Mean Dispersion Factor at 1 km For All Locations

Year	s/m³
1984	2E-07
1985	1E-07
1986	1E-07

(1) Excluding the Reference location A01R.

* This value includes a second source term i.e., contaminated containers temporarily located in this facility in 1984, and should be ignored in the evaluation of dilution factors.
In the calculation of the mean, all of the 'less than' data were taken as real.

To derive a mean dispersion factor at 1 km from the stack, for all locations, each dispersion factor value is corrected to 1 km by tracing back between dispersion curves on the graph of Weighted Mean Dilution Factor versus Distance from the Point of Continuous Emission (reproduced in the DEL licensing document referred to previously). The mean of these corrected figures is presented in the lower part of Table 5.1. The figures for the pumphouse location, too close to the point of release to be reliable, were ignored in these calculations.

5.4 Airborne Carbon-14 - Table 4.04.

Carbon-14 collection and analysis was started in 1983. Results for 1986 are summarized in table 4.04. Values are generally below the Lower Limit of Detection.

5.5 Environmental Gamma Radiation

5.5.1 TLD data - Tables 4.05A and 4.05B

Radiation levels during 1986, as measured by TLDs, are comparable with those measured since 1976.
Six new locations adjacent to the containment building in a sector from ENE to S were added in mid 1986.
None of the environmental TLD measurements shows any background radiation level significantly different from that seen before PLGS became operational. Variation in natural background radiation at any location covers a range of about 300 microgray in a year.
The contribution of fallout radioactivity from Chernobyl to background radiation could not be detected above the usual background signal.
Only one TLD was not recovered this year.

5.5.2 Gamma Survey Measurements Table 4.06

Environmental gamma survey measurements are made in the inter-tidal zone on beaches in the Point Lepreau area and at the Reference location, Q01R, 28 km to the ENE. Although TLDs are preferred in measuring such exposures since they span the entire year and provide integrated measurements, they are not suitable for use in these locations. Radiation levels in 1986 are consistent with those seen over the last few years.

5.6 Sediments - Tables 4.07A, 4.07B

Sediments collected from beaches and tidal mud flats contain radioactivity, both from naturally occurring radionuclides and from the diminishing levels of Cs-137 fallout from bomb tests since the 1950s. A small additional Cs-137 component (and Ru-103 in one sample) from Chernobyl was added to this reservoir in 1986, but was not obvious in most samples. A summary of the Cs-137 levels in sediments over the last nine years is given in table 4.07B.

5.7 Soil

No soil samples were analyzed this year.

5.8 Well Water - Table 4.08

No gamma emitting radionuclides other than those occurring in nature, were detected in water samples during this sampling period or at any time since measurements were started. Only one sample contained detectable tritium which was at an activity level within the range of the Critical Levels on these samples.

5.9 Bore Hole Water (SRWMF) - Table 4.09

Waters from Bore Holes on the SRWMF site were analyzed to assess levels of radionuclides. Tritium, as tritiated water, was detected in 11 of 12 samples at an average level of about 60 Bq/L, ranging from 30 to 70 Bq/L. No other radionuclides attributable to the operation of PLGS were detected.

5.10 Parshall Flume (SRWMF)-Table 4.10

Rain water, draining from the SRWMF in a specially constructed drainage channel (flume), is collected and analyzed on a regular basis. An absence of rain at the time that radionuclides from Chernobyl were passing over the area may be responsible for the absence of expected washout radionuclides in the runoff. Tritium was detected in 56 of the 57 Parshall Flume water analyses, ranging from 19 to 400 Bq/L. Niobium-95 (1 Bq/L) and Co-60 (9 Bq/L) were detected in one sample in September. A sample collected in October contained Co-60 (0.8 Bq/L). These radionuclides originated at PLGS but the specific source could not be determined because of the low concentrations and transitory nature of their appearance. No other gamma emitting radionuclides, except for those that occur naturally, were detected in any of the samples.

5.11 Lagoon Water and Lagoon Sludge - Tables 4.11 and 4.12

Inactive-drainage liquid waste from PLGS is collected in drainage lagoons on the site. Samples of both the water and the sludge are analyzed. Tritium was detected in all 38 of the water samples, ranging from 40 to 60000 Bq/L. The highest tritium concentrations occurred during the boiler tube leak in the first quarter of the year. Niobium-95 (0.6 Bq/L), Cs-137 (0.6 Bq/L) and Ru-103 (0.4 Bq/L) were detected in different sludge samples in February, June and July respectively. The specific activities of these radionuclides are all close to the Critical Levels for these radionuclides in these samples. Although this drainage system is normally inactive, radionuclides appear from time to time due to their presence in sumps and drains which are ultimately emptied to the lagoons. The liquids from these lagoons are drained to the Condenser Cooling Water duct, hence the pathway to the environment is the same as for other liquid effluents. Solids from the lagoons are disposed of in a controlled landfill location.

5.12 Sea Water - Table 4.13

Naturally occurring K-40 was the only gamma emitting radionuclide found in sea water during the sampling period. Natural tritium levels in sea water are generally below the detection limit of the present analytical procedure.
Calculations show that the average concentration of tritium in sea water due to releases from PLGS in the liquid effluent pathway in 1986, was about 7 Bq/L beyond the outfall. Because releases are not continuous, the concentrations of tritium released in the cooling water flow may range from not detectable to several hundred Bq/L at the outfall discharge. Depending upon the time of collection of sea water samples relative to the pumpout time, tritium may be detectable at sample collection locations. No attempt is made to coordinate sample collection with pumpout times, and sample collection tends to be made at low tide. Only one sea water sample of the 14 collected in the Point Lepreau area this year, contained detected tritium (22 Bq/L); just above the range of Critical Levels of 19 to 21 Bq/L for the detection of tritium in sea water at this time.

5.13 Milk - Table 4.14 and Table 3 in Appendix 1

Milk from a commercial dairy and milk samples from herds in the south of the province are analyzed on a regular basis. There are no commercial herds producing milk in the Point Lepreau area. The closest herds to PLGS are in St. Andrews and Fredericton Junction, and the milks from these locations are sampled for analysis. Cs-137 from bomb tests in the 1950's through to as recent as 1980, was detected at low specific activity levels in milk.
Since May of this year, after the accident at Chernobyl, there has been a slight increase in the Cs-137 content of milk, (0.1 to 0.5 Bq/L) with Cs-134 (0.1 to 0.2 Bq/L) also being identified. I-131, (0.1 to 0.4 Bq/L), with its short half life (8 days) was detected for about two weeks. Samples of milk collected outside of the usual environmental monitoring program were analyzed to provide additional data on Chernobyl fallout. The additional data are in Table 3, Appendix 1.
Natural radionuclides (potassium-40, at about 50 Bq/L and daughters of natural uranium and thorium) occur in milk. Potassium-40 is associated with stable potassium in all foods, but the presence of the other natural radionuclides depends upon their availability in the local area from natural mineral deposits and the condition of the pasture.
No radionuclides from the operation of PLGS have yet been detected in milk.

5.14 Seafood - Tables 4.15 to 4.21

All of the seafoods analyzed in the environmental program contain naturally occurring radionuclides e.g., K-40. No contributions from the operation of Point Lepreau were detected even though several of the samples (consisting of crabs, scallops and

lobster) were collected at the cooling water outflow from PLGS. Dulse, an edible seaweed, is included in this category as it comprises a popular delicacy and snack food in this region. None of the eight dulse samples collected in the year showed any radionuclides attributable to either the Chernobyl accident or PLGS emissions.

5.15 Sea Plants - Table 4.22

Seaweeds other than Dulse are analyzed. Various species of seaweed, (for example, Ascophylum) are readily available from the rocks on the Point Lepreau peninsula close to the outfall and are collected from time to time. Iodine-131 (2 Bq/kg) was detected in one of the thirteen samples analyzed. The seaweed was collected from the tidally exposed rocks in Maces bay on 86-05-14 at the time when fallout from Chernobyl in the region was close to its peak. Emissions of I-131 from PLGS were minimal at this time, (see Figure 6.4).

5.16 Vegetation (Lichen) - Table 4.23 and Appendix 1

Different species of lichen and moss concentrate a wide range of radionuclides and are sensitive indicators of radionuclides in the environment. Activity levels in tree lichen before April 1986 of, for example, Cs-137 (20 to 100 Bq/kg), were mostly a result of fallout from the 1980 Chinese bomb test as well as previous atmospheric tests. An increase in specific activity levels of Cs-137 and of comparatively short half life radionuclides (Cs-134 and I-131) after April, especially in ground moss, resulted from the Chernobyl accident. The long half life of Cs-137 and its relative persistence in soils with abundant organic matter, will ensure its presence in mosses for some time into the future. Although there is no consistent means of correlating atmospheric concentration and uptake into the lichen or moss, these plants are rapid indicators of the presence of airborne radionuclides and possibly also of various other airborne pollutants in the environment.

5.17 Sr-90 Analyses - Tables 4.24A and 4.24B.

Strontium-90 analyses were made on both gaseous effluent (GEM) and liquid effluent (LEM) samples from PLGS covering the entire year. Radiostrontium was detected close to the LLD in one of the 52 GEM samples and in seven of the twelve LEM samples. Eight air particulate samples from the environmental air monitoring program for the latter half of May, (Table 2, Appendix 1) were analyzed to check the contribution of strontium-90 from Chernobyl. Strontium-90 was detected in one sample where the activity was just above the Critical Level.

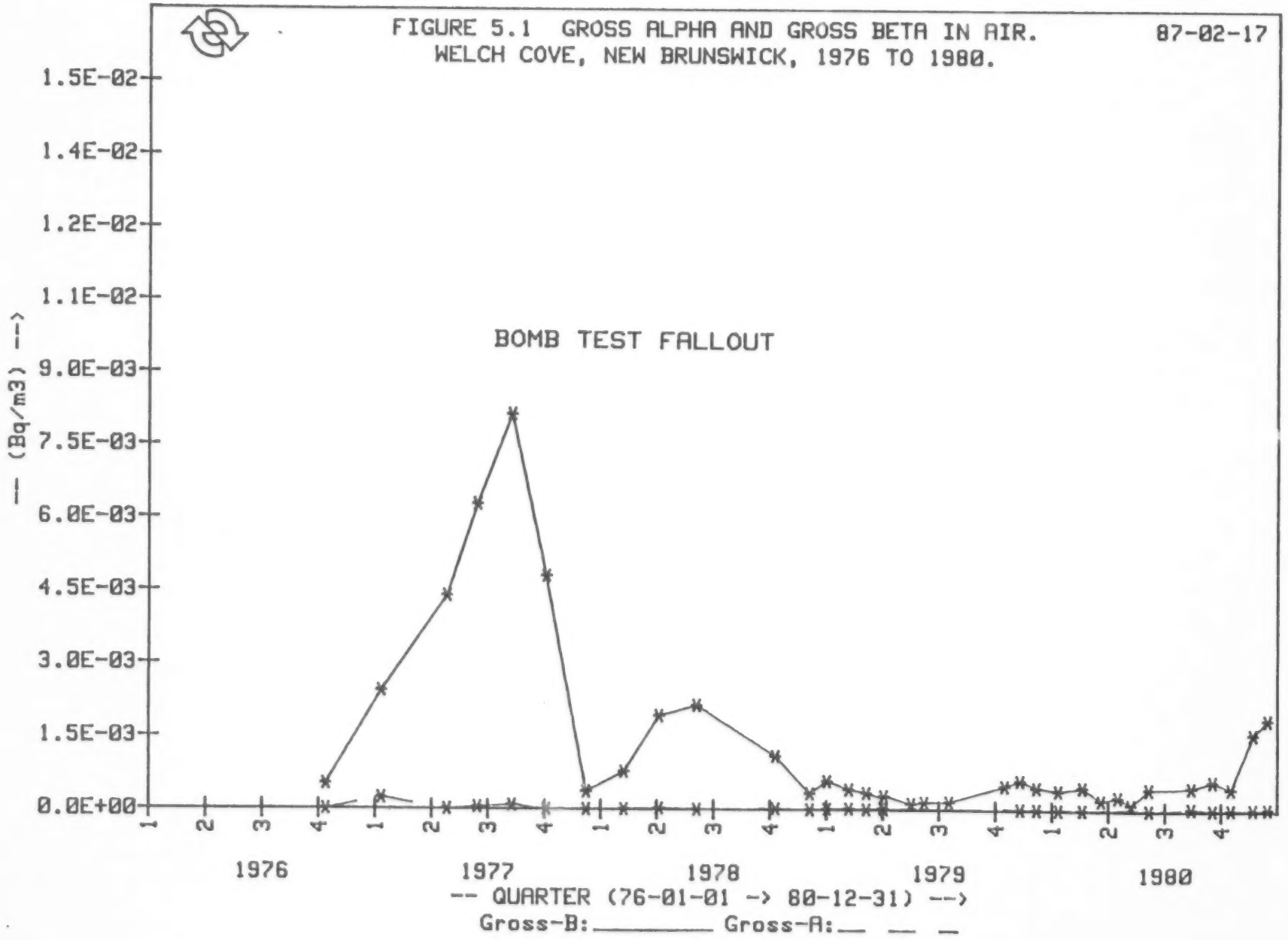


FIGURE 5.1 GROSS ALPHA AND GROSS BETA IN AIR.
WELCH COVE, NEW BRUNSWICK, 1976 TO 1980.
87-02-17
1.5E-02
1.4E-02
1.2E-02
1.1E-02
9.0E-03
7.5E-03
6.0E-03
4.5E-03
3.0E-03
1.5E-03
0.0E+00
-- (Bq/m3) -->
BOMB TEST FALLOUT
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
1976
1977
1978
1979
1980
-- QUARTER (76-01-01 -> 80-12-31) -->
Gross-B:_____ Gross-A:__ __ __

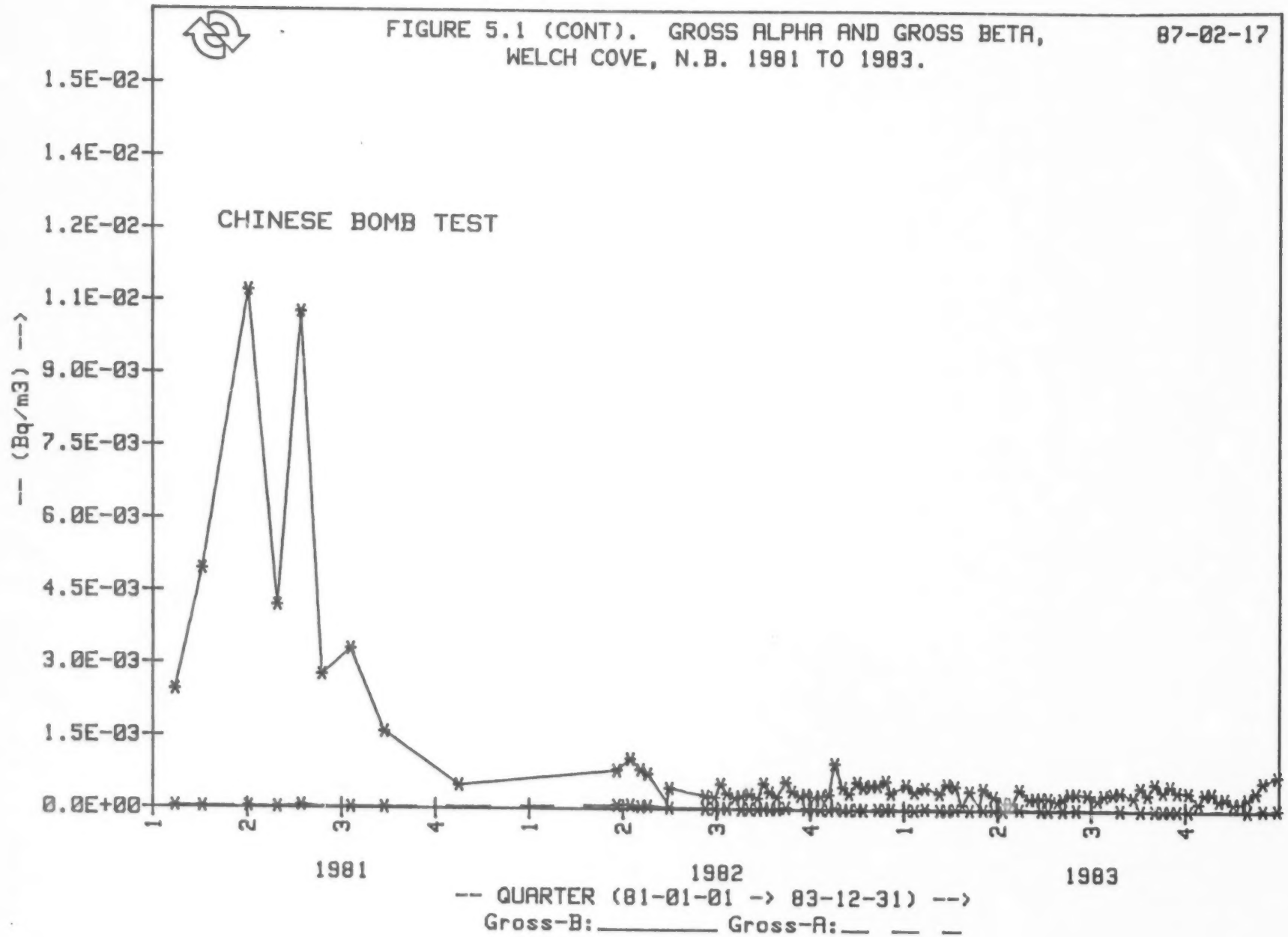


FIGURE 5.1 (CONT). GROSS ALPHA AND GROSS BETA,
WELCH COVE, N.B. 1981 TO 1983.
87-02-17
1.5E-02
1.4E-02
1.2E-02
1.1E-02
9.0E-03
7.5E-03
6.0E-03
4.5E-03
3.0E-03
1.5E-03
0.0E+00
-- (Bq/m3) -->
CHINESE BOMB TEST
1 2 3 4 1 2 3 4 1 2 3 4
1981
1982
1983
-- QUARTER (81-01-01 -> 83-12-31) -->
Gross-B:_____ Gross-A:__ __ __

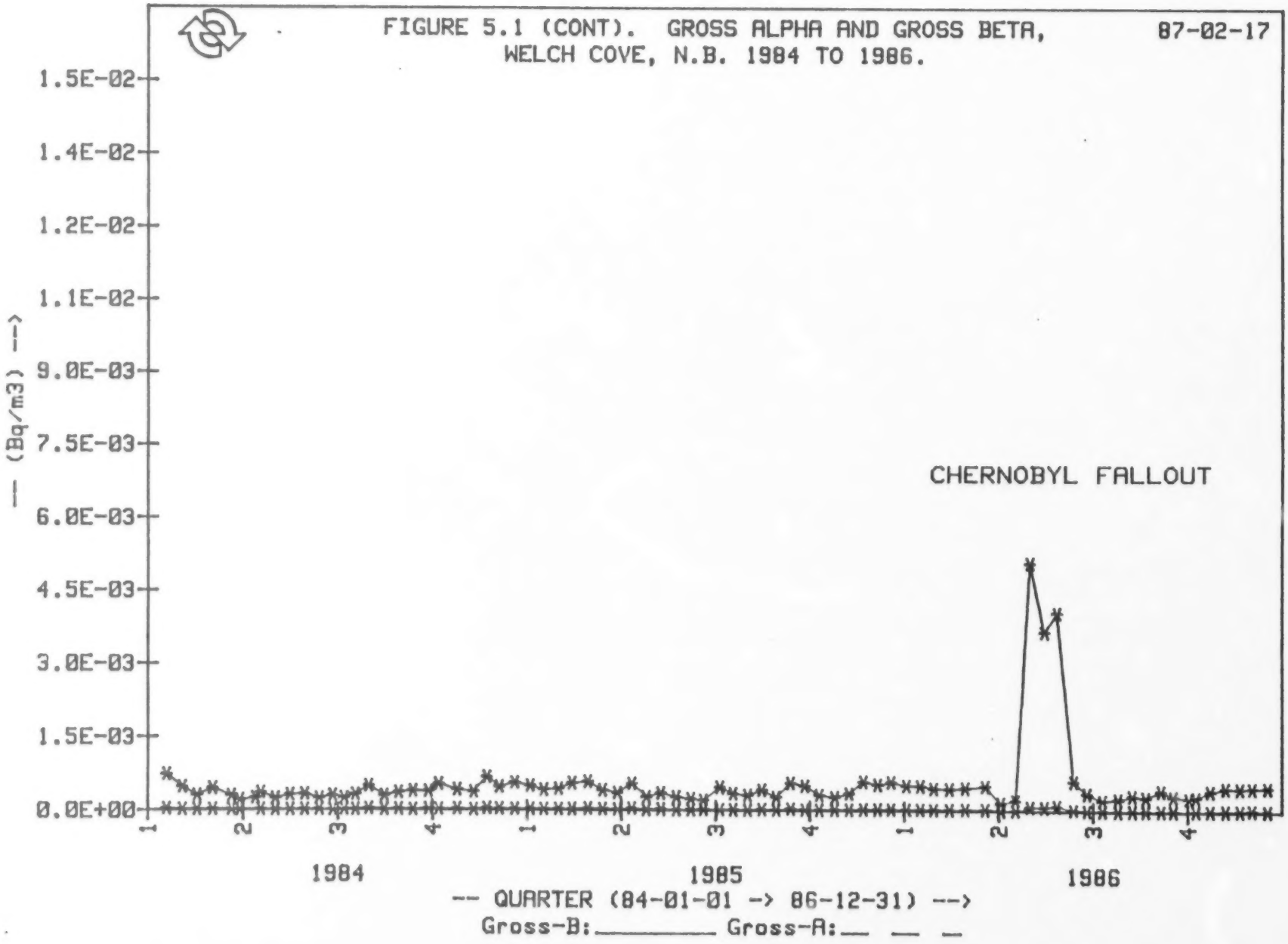


FIGURE 5.1 (CONT). GROSS ALPHA AND GROSS BETA,
WELCH COVE, N.B. 1984 TO 1986.
87-02-17
1.5E-02
1.4E-02
1.2E-02
1.1E-02
9.0E-03
7.5E-03
6.0E-03
4.5E-03
3.0E-03
1.5E-03
0.0E+00
-- (Bq/m3) -->
CHERNOBYL FALLOUT
1 2 3 4 1 2 3 4 1 2 3 4
1984
1985
1986
-- QUARTER (84-01-01 -> 86-12-31) -->
Gross-B:_____ Gross-A:__ __ __

6.0 SOURCE EMISSION DATA FROM POINT LEPREAU.

The source emissions data are reproduced from the PLGS Quarterly Technical Reports concerning station operation and data.

Tables 6.1 and 6.2, summarize the emissions from PLGS since startup in 1982. Figure 6.1, shows the power level achieved since that time, on a monthly basis.

The information for the Liquid Effluent and Airborne pathways from PLGS is used not only to control the frequency of sample collection in the Environmental Monitoring Program but also to indicate which pathways and sample types may need to be more closely examined.

To the present time, tritium is the only radionuclide attributable to the operation of PLGS, which is detected off-site. The correlation between observed and expected tritium levels in the air monitoring stations indicates that in the airborne pathway, the assumed Dilution Factor of 2.2E-07 s/m^3 used in the DEL licensing document is sufficiently accurate.

Calculation of the expected tritium activity levels in sea water, based upon emission data for the year, suggests that the average tritium content of sea water in the outfall area, due to emissions from PLGS in 1986, was about 7 Bq/L. This is below the 20 Bq/L Critical Level for its detection by present methods of analysis. Variation in release rates however, may cause tritium occasionally to exceed the Critical Level for its detection at the nearest point of environmental sample collection less than 1 km from the outfall.
Only one of 14 locally collected sea water samples contained detectable tritium (22 Bq/L). The data to date suggest therefore that the assumed 20 times dilution factor beyond the outfall, due to tidal mixing, is not unreasonable.

No other radionuclides have been emitted in sufficient quantity since PLGS became operational to be seen in any environmental sample.

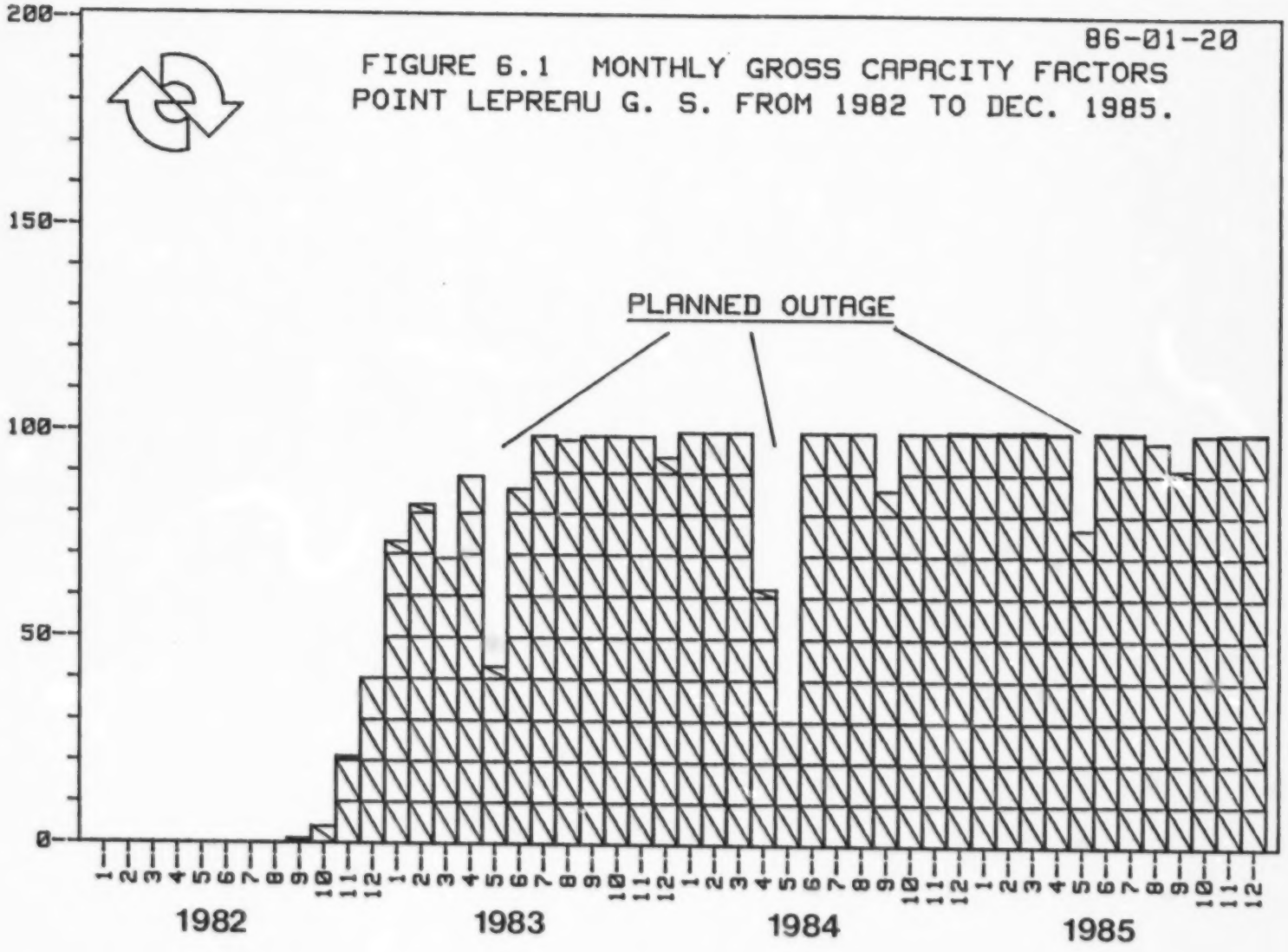

86-01-20
FIGURE 6.1 MONTHLY GROSS CAPACITY FACTORS
POINT LEPREAU G. S. FROM 1982 TO DEC. 1985.
200
150
100
50
0
PLANNED OUTAGE
1982
1983
1984
1985
MONTHLY INTERVAL (%)

Table 6.1

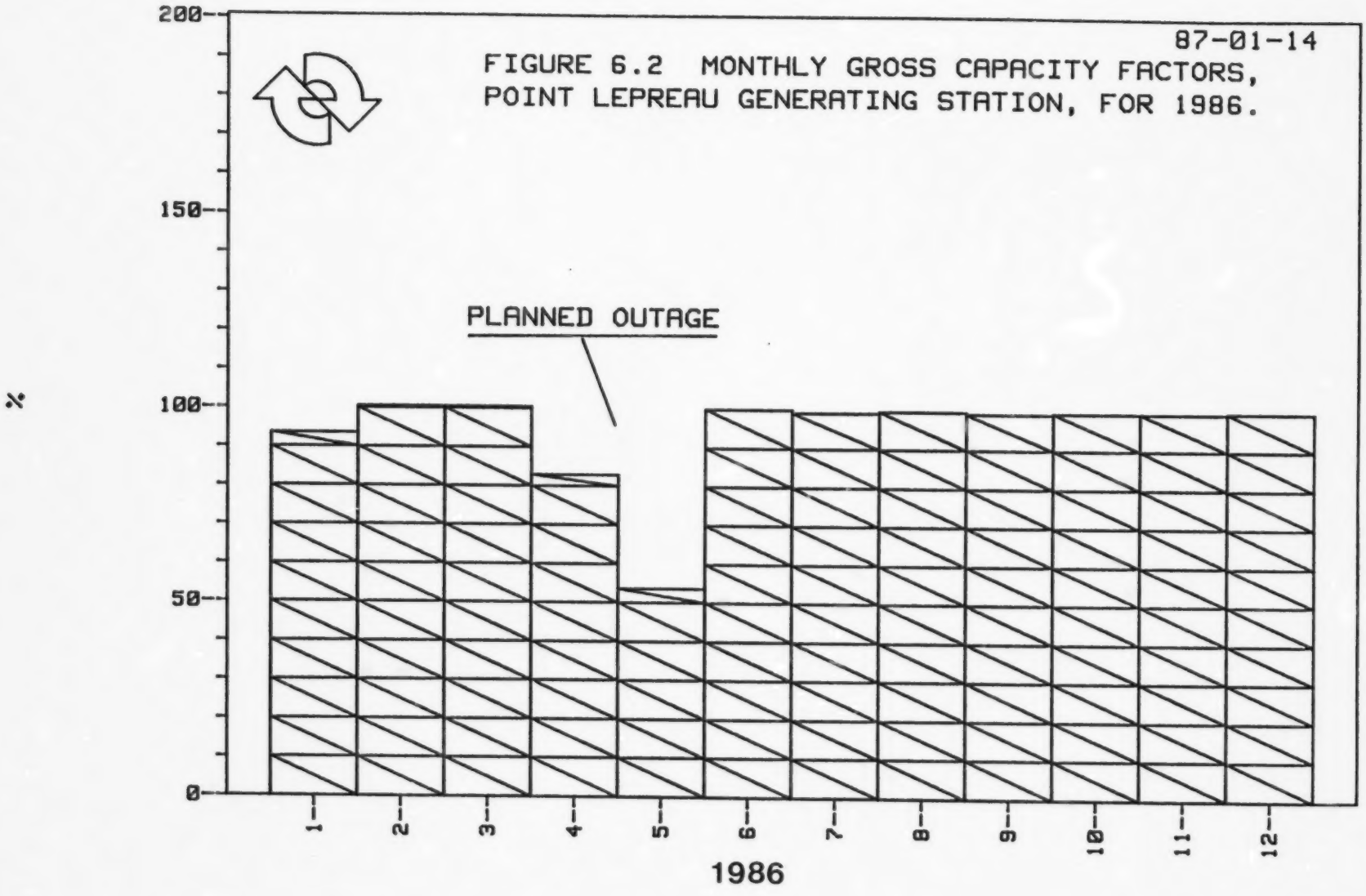
Liquid Effluent Pathway Emission Data (%DEL)

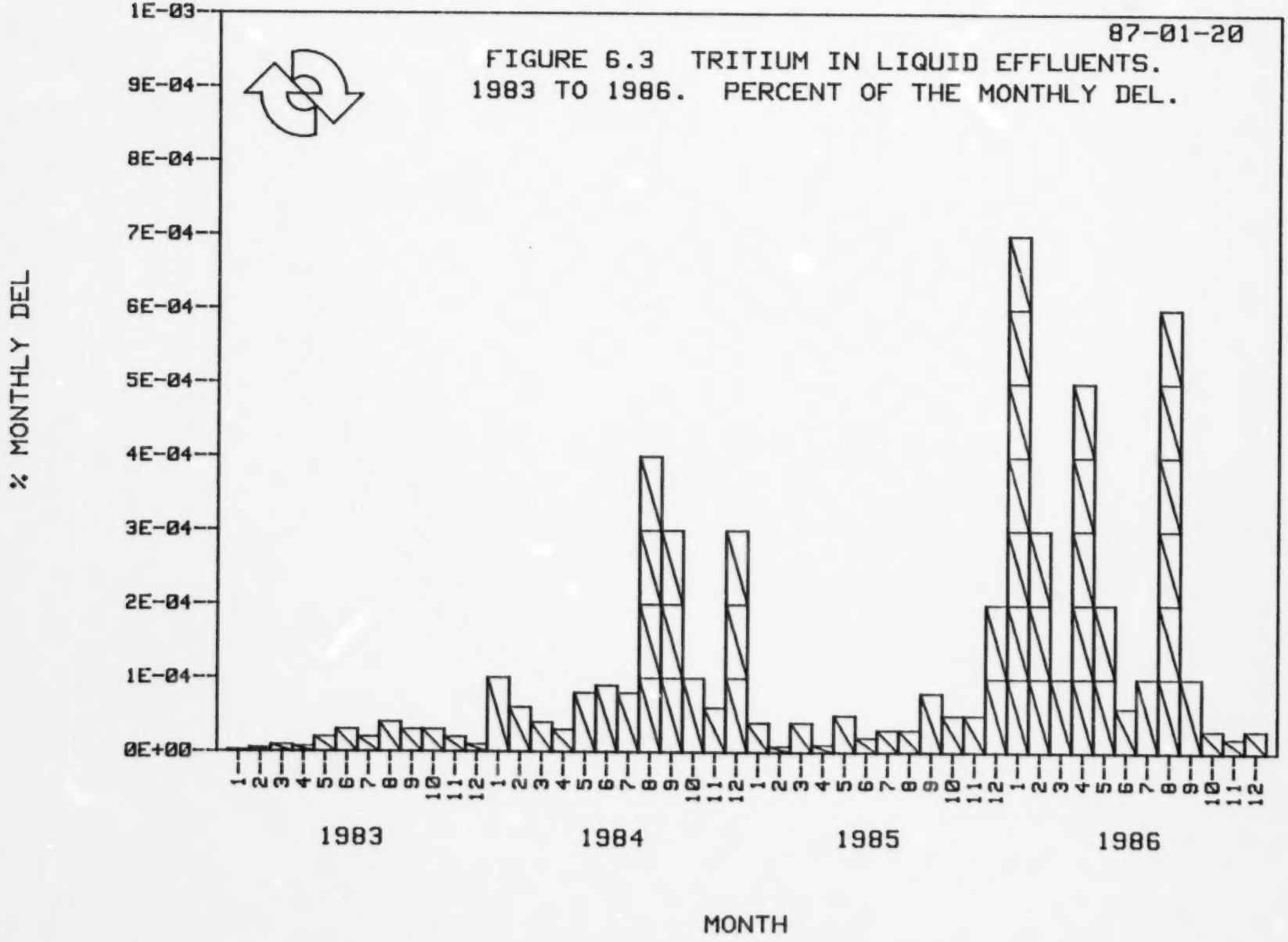
Radio-nuclide	MONTHLY DEL (Bq)	1983	1984	1985	1986
H-3	4E+18	1.9E-05	1.5E-04	5.1E-05	2.3E-04
Cr-51	2E+15	3.2E-06	4.7E-05	1.2E-07	9.0E-08
Mn-54	2E+13	1.2E-07	9.2E-05	6.0E-07	8.3E-06
Co-58	7E+13	.....	1.0E-06	.....	.....
Fe-59	1E+13	1.6E-05	7.2E-05	1.6E-06	.....
Co-60	3E+13	2.3E-06	8.1E-05	4.1E-06	1.2E-05
Zn-65	9E+12	.....	4.1E-07	1.8E-07	7.5E-06
Sr-90	2E+14	.....	2.2E-08	3.8E-10	6.0E-07
Zr-95	6E+13	7.4E-06	3.9E-05	1.7E-05	4.8E-05
Nb-95	6E+13	1.2E-05	7.1E-05	2.9E-05	8.2E-05
Ru-103	1E+14	4.6E-07	5.7E-09	4.2E-07	9.1E-07
Ru-106	2E+13	.....	1.3E-06	.....	.....
Ag-110m	1E+13	1.8E-07	7.3E-08	4.0E-07	4.9E-06
I-131	1E+13	1.4E-03	3.4E-05	8.2E-04	3.3E-05
Cs-134	4E+13	1.8E-07	2.3E-06	6.7E-08	3.7E-07
Cs-137	7E+13	.....	7.6E-06	7.9E-07	3.1E-06
La-140	2E+14	3.6E-08	1.1E-08	.....	.....
Ba-140	2E+14	.....	.....	.....	.....
Ce-141	2E+14	2.5E-08	1.1E-08	.....	.....
Ce-144	2E+13	3.3E-06	8.1E-07	5.4E-07	1.6E-06

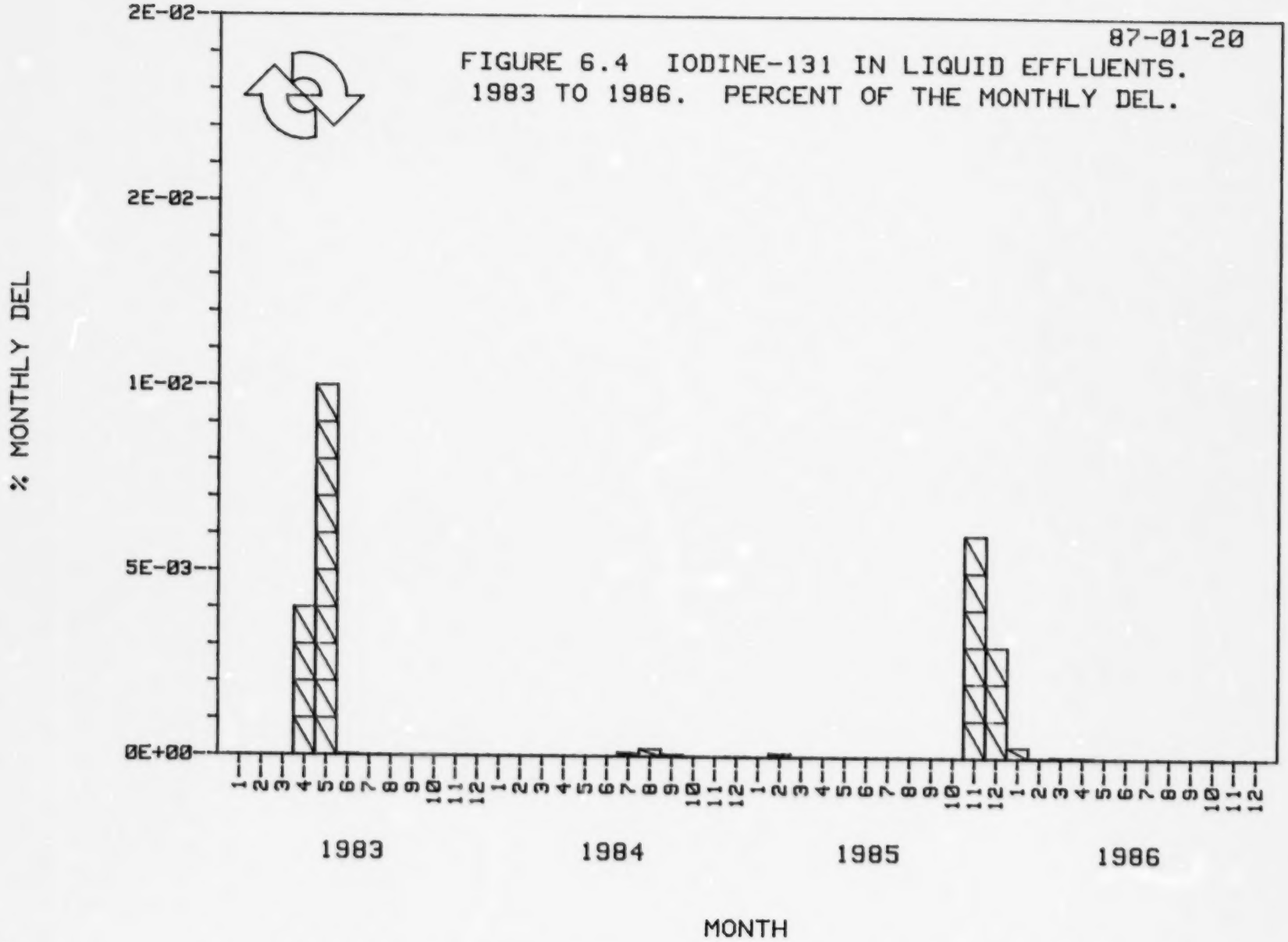
Table 6.2

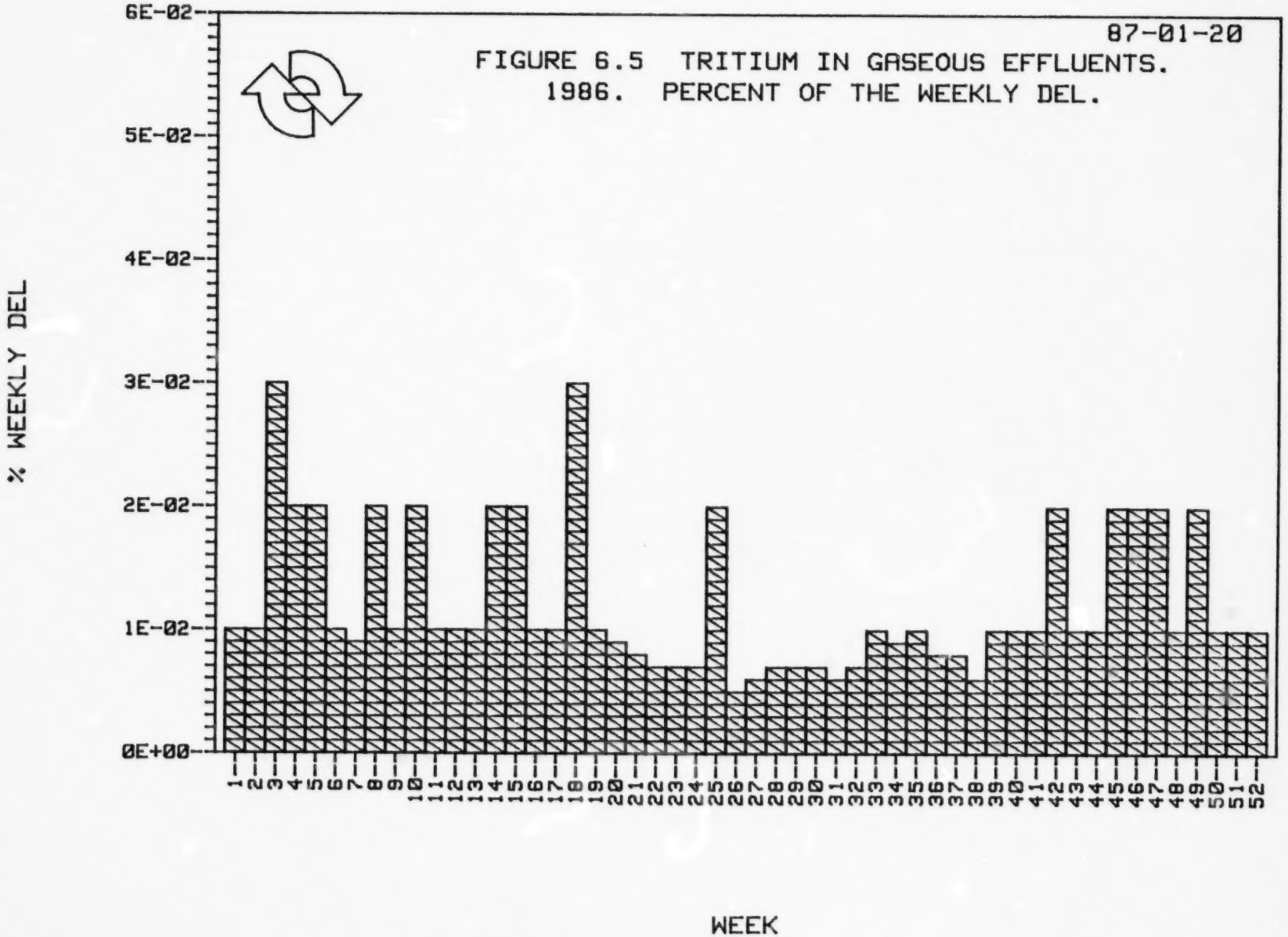
Gaseous Effluent Pathway Emission Data (%DEL)

Radio-nuclide	WEEKLY DEL (Bq)	1983	1984	1985	1986
H-3	3E+16	1.6E-03	4.3E-03	6.8E-03	1.3E-02
Co-60	9E+12	.....	.....	.....	.....
Ru-106	4E+12	.....	.....	.....	.....
I-131	5E+10	3.6E-04	.....	1.5E-04	1.1E-03
Cs-134	2E+12	.....	.....	.....	.....
Cs-137	5E+12	.....	.....	.....	.....
Noble Gas	7E+15	1.2E-03	.....	2.5E-04	1.5E-03


87-01-14
FIGURE 6.2 MONTHLY GROSS CAPACITY FACTORS,
POINT LEPREAU GENERATING STATION, FOR 1986.
200
150
100
50
0
%
PLANNED OUTAGE
1
2
3
4
5
6
7
8
9
10
11
12
1986
MONTHLY INTERVAL


87-01-20
FIGURE 6.3 TRITIUM IN LIQUID EFFLUENTS.
1983 TO 1986. PERCENT OF THE MONTHLY DEL.
% MONTHLY DEL
1E-03
9E-04
8E-04
7E-04
6E-04
5E-04
4E-04
3E-04
2E-04
1E-04
0E+00
1983
1984
1985
1986
MONTH


87-01-20
FIGURE 6.4 IODINE-131 IN LIQUID EFFLUENTS.
1983 TO 1986. PERCENT OF THE MONTHLY DEL.
% MONTHLY DEL
2E-02
2E-02
1E-02
5E-03
0E+00
1983
1984
1985
1986
MONTH


87-01-20
FIGURE 6.5 TRITIUM IN GASEOUS EFFLUENTS.
1986. PERCENT OF THE WEEKLY DEL.
% WEEKLY DEL
6E-02
5E-02
4E-02
3E-02
2E-02
1E-02
0E+00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
WEEK

7.0 METEOROLOGICAL DATA AROUND POINT LEPREAU G.S.

The meteorological data for the 10 metre weather tower in the Point Lepreau area are presented in Table 7.01 and Figures 7.1 and 7.2.
As long term weather data are not available for this location, data for the last twenty years for both Fredericton and Saint John, the nearest locations for which such data are available, are presented in Tables 7.02 and 7.03.

TABLE 7.01 METEOROLOGICAL DATA FOR 1986, POINT LEPREAU, NEW BRUNSWICK.

Month	Temperature Av	Mean daily Max	Mean daily Min	Extreme Max	Extreme Min	Wind direction % Observations From * N	NE	E	SE	S	SW	W	NW	Pasquill stability classes A	B	C	D	E	F	G	UNAV.
	°C	°C	°C	°C	°C	Relative %								Relative %							%
January	-5.5	-1.5	-9.7	9.4	-23.2	16	7	19	13	5	6	11	23	50	10	5	18	12	4	1	30
February	-5.6	-2.1	-9.2	1.7	-16.9	19	13	3	2	3	6	19	34	38	20	15	20	6	1	1	#
March	-1.4	0.5	-5.9	11.6	-17.2	9	9	6	1	15	24	14	22	27	12	7	27	20	5	2	6
April	4.2	7.1	1.8	14.9	-4.3	25	24	15	6	13	7	3	7	16	5	7	29	30	7	6	3
May	7.3	10.1	5.1	16.6	-1.0	12	20	7	3	17	25	11	5	13	6	8	31	25	9	8	16
June	11.1	14.0	8.7	19.7	4.5	4	11	17	3	15	24	18	8	6	4	4	21	40	16	9	1
July	13.8	16.8	11.3	23.5	8.8	6	22	7	3	12	25	15	10	3	3	2	19	40	20	13	11
August	13.9	16.3	11.5	21.6	8.6	7	8	9	7	19	26	18	6	2	1	2	13	35	27	21	7
September	11.0	13.4	8.4	16.8	4.9	12	5	6	4	14	29	14	16	4	2	3	14	33	27	16	10
October	7.9	10.3	5.2	18.6	-1.3	15	5	5	3	10	23	15	24	10	7	8	29	27	11	7	4
November	1.7	5.0	-2.4	10.8	-12.5	20	8	4	3	10	15	17	24	13	7	11	32	23	11	3	1
December	-2.1	2.0	-6.2	10.2	-18.4	15	10	6	5	2	11	27	25	25	10	11	31	16	6	3	#
Means	4.8	7.9	1.8			13	12	8	4	11	18	15	17	17	7	7	24	26	12	8	7
Years	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

10 Metre Tower data, 1986.

* Each compass direction covers + and - 22.5 degrees.

UNAV means that percentage of time that the instrumentation was unavailable and could not record the weather.

\# means unavailable less than 1% of the time.

TABLE 7.02 METEOROLOGICAL DATA FOR SAINT JOHN AIRPORT, NEW BRUNSWICK.(*)

1951 - 1980.

		Temperature							Precip		Days with					Wind direction % Observations From									
			Mean daily		Extreme																				
Month	P	Av	Max	Min	Max	Min	RH	CC	Av	24h	r	s	ppt	f	th	N	NE	E	SE	S	SW	W	NW	c	as
	kPa	°C	°C	°C	°C	°C	%	%	mm	mm															knots
Jan	101.4	-7.8	-2.6	-12.9	14.0	-31.7	82	64	148.8	83.0	6	13	17	3	0.2	22	6	7	4	5	7	18	27	4	11.3
Feb	101.2	-7.5	-2.2	-12.8	11.1	-36.7	80	59	115.7	95.0	5	12	14	3	0.1	19	7	8	5	8	9	18	22	4	11.1
Mar	101.3	-2.5	2.1	-7.1	13.9	-30.0	77	63	114.1	74.0	7	11	14	5	0.1	22	8	9	5	9	8	15	21	3	11.5
Apr	101.4	3.2	7.9	-1.5	22.8	-16.7	75	65	107.3	125.5	10	5	13	6	0.7	20	7	8	8	16	11	11	14	5	10.4
May	101.4	9.0	14.4	3.6	30.0	-7.8	72	68	107.7	66.5	13	1	14	10	0.8	12	6	9	9	25	16	7	11	5	10.1
Jun	101.3	13.8	19.2	8.4	31.7	-2.2	77	70	94.2	54.1	14	0	13	12	2.7	10	6	8	9	33	17	5	7	5	9.7
Jul	101.4	16.9	22.2	11.6	32.8	1.1	80	65	103.4	72.6	12	0	12	17	3.0	7	3	6	8	39	17	7	7	6	8.8
Aug	101.5	16.6	21.7	11.4	34.5	-0.6	82	60	102.0	125.2	12	0	12	14	2.5	9	4	4	8	33	16	9	10	7	8.6
Sep	101.8	12.7	17.6	7.7	28.9	-6.7	82	57	111.8	74.9	12	0	12	13	1.1	12	6	7	7	25	13	9	13	8	9.0
Oct	101.7	7.6	12.1	3.1	25.6	-10.6	83	57	127.7	85.3	12	1	12	9	0.6	15	7	5	7	19	14	14	14	5	10.1
Nov	101.5	2.3	6.3	-1.6	21.7	-15.3	85	68	145.7	154.4	13	4	15	5	0.2	19	7	7	8	12	8	16	19	4	10.8
Dec	101.5	-4.8	-0.1	-9.3	16.1	-30.9	82	62	166.0	105.7	8	12	16	3	0.1	22	7	5	5	7	7	17	26	4	11.2
Means	101.5	5.0	9.9	0.1												15	6	7	7	20	12	12	16	5	10.3
Totals									1444		124	58	164	99	12.1										
Extremes					32.8	-36.7				125.5															
Years	20	30	30	30	30	30	10	13	30	30	22	22	22	30	20	18	18	18	18	18	18	18	18	18	18

* Data mostly from "Small Craft Guide to the Saint John River." available from Canadian Hydrographic Service, Dept. of Fisheries and Oceans, 1675 Russell Road, Ottawa, Ont., K1G 3H6.

P	Mean Sea Level Pressure in kiloPascals.
Av	Average Monthly Temperature.
RH	Relative Humidity in percent.
CC	Cloud Cover in percent.
Precip. Av	average total precipitation in millimetres for the month.
Precip. 24h	maximum precipitation in millimetres recorded in 24 hours.
r,s,ppt,f,th	Days with rain, snow, precipitation, fog and thunder respectively.
c	percentage of observations that have calm winds.
as	mean wind speed in knots.

TABLE 7.03 METEOROLOGICAL DATA FOR FREDERICTON AIRPORT, NEW BRUNSWICK.(*)

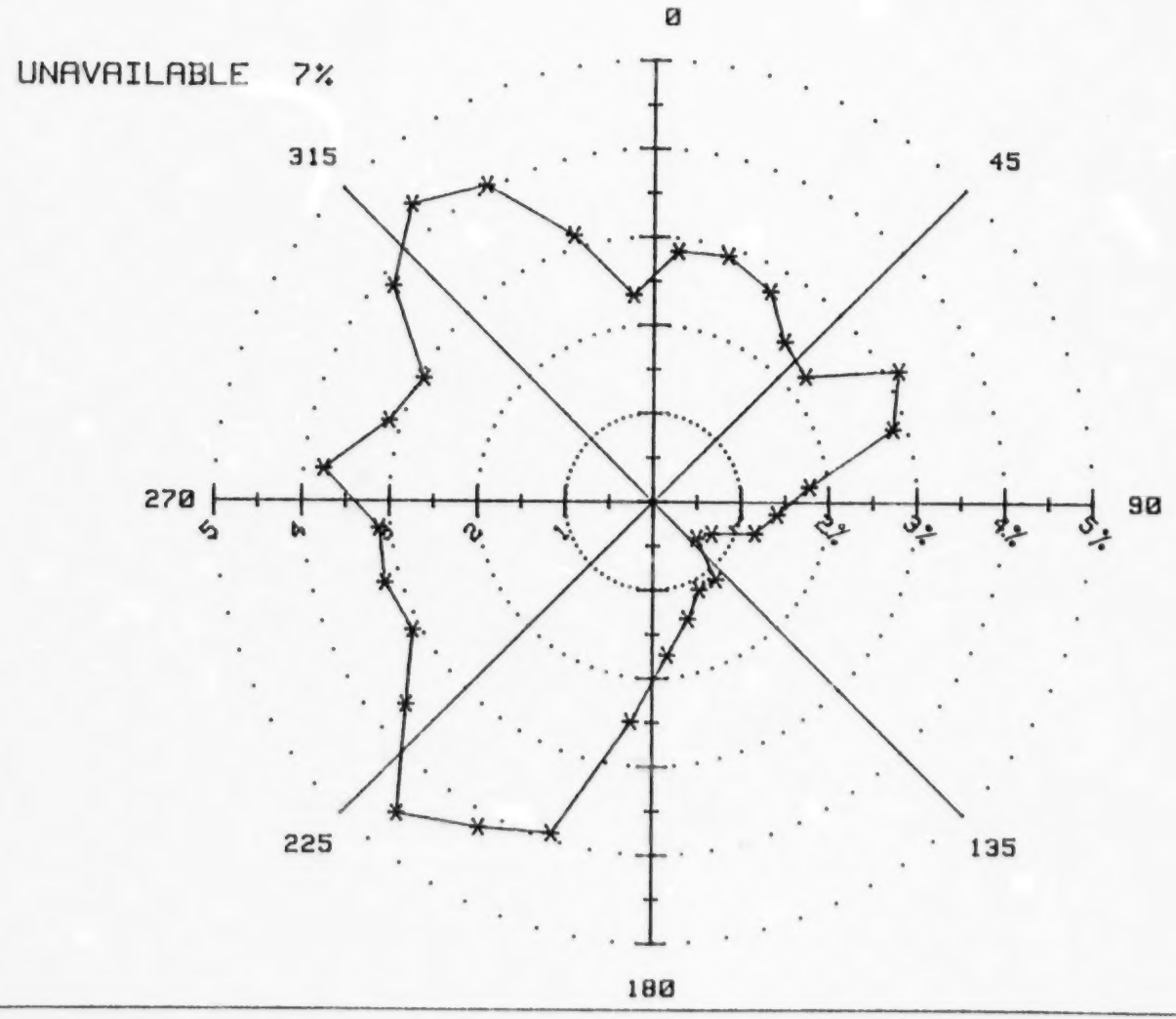
Month	P	Temperature Mean daily Av	Mean daily Max	Mean daily Min	Extreme Max	Extreme Min	RH	CC	Precip. Av	Precip. 24h	Days with r	s	ppt	f	th	Wind direction % Observations From N	NE	E	SE	S	SW	W	NW	c	ms
	kPa	°C	°C	°C	°C	°C	%	%	mm	mm															knots
Jan	101.6	-8.8	-3.7	-14.0	11.1	-33.9	72	61	95.3	38.4	5	12	15	2	0.0	7	9	4	2	7	15	28	16	12	8.2
Feb	101.2	-8.1	-2.3	-13.8	13.3	-37.2	73	59	92.5	51.8	3	11	13	2	0.0	6	12	5	2	10	14	26	13	12	8.2
Mar	101.2	-2.4	2.5	-7.4	22.2	-24.4	70	61	69.1	37.9	5	9	12	2	0.1	10	13	7	2	9	10	23	17	9	8.7
Apr	101.3	4.2	9.6	-1.3	24.4	-14.4	64	64	73.9	58.7	10	4	12	2	0.5	11	12	7	4	14	10	17	15	10	8.1
May	101.3	10.6	16.9	4.1	32.8	-6.7	62	65	81.3	83.8	13	0	13	2	1.1	8	11	7	5	21	13	14	13	8	8.0
Jun	101.2	16.1	22.6	9.6	35.0	0.0	67	66	79.3	69.9	13	0	13	3	2.2	6	10	5	6	30	15	12	8	8	7.5
Jul	101.3	19.2	25.6	12.8	36.7	1.7	70	57	88.1	69.1	12	0	12	4	3.8	4	5	3	5	34	17	13	8	11	6.9
Aug	101.4	18.1	24.3	11.7	36.1	1.7	72	58	87.6	76.5	11	0	11	4	3.0	3	5	3	5	30	18	16	9	11	6.7
Sep	101.6	13.4	19.6	7.2	32.8	-2.8	75	54	81.8	71.9	10	0	10	6	0.7	5	8	4	4	24	17	16	11	11	6.7
Oct	101.7	7.8	13.3	2.3	27.8	-8.9	77	59	88.1	54.6	11	1	11	5	0.5	7	9	3	3	20	17	18	12	11	7.3
Nov	101.5	1.7	6.0	-2.6	21.1	-17.8	80	66	109.2	81.0	11	5	14	5	0.1	8	12	5	4	13	15	20	12	11	7.5
Dec	101.5	-6.2	-1.5	-10.8	15.0	-32.2	77	62	114.1	81.3	6	12	15	3	0.1	7	9	4	2	9	15	26	15	13	7.9
Means	101.4	5.5	11.1	-0.2												7	10	4	3	19	15	19	12	11	7.7
Totals									1060		110	54	151	40	12.1										
Extremes					36.7	-37.2				83.8															
Years	20	20	20	20	20	20	10	10	20	20	20	20	20	30	20	18	18	18	18	18	18	18	18	18	18

* Data from "Small Craft Guide to the Saint John River." available from Canadian Hydrographic Service, Dept. of Fisheries and Oceans, 1675 Russell Road, Ottawa, Ont., K1G 3H6.

P	Mean Sea Level Pressure in kiloPascals.
Av	Average Monthly Temperature.
RH	Relative Humidity.
CC	Cloud Cover in percent.
Precip. Av	Total precipitation in millimetres for the month.
Precip. 24h	maximum precipitation in millimetres recorded in 24 hours.
r,s,ppt,f,th	Days with rain, snow, precipitation, fog and thunder respectively.
c	percentage of observations that have calm winds.
ms	mean wind speed in knots.

87-01-20

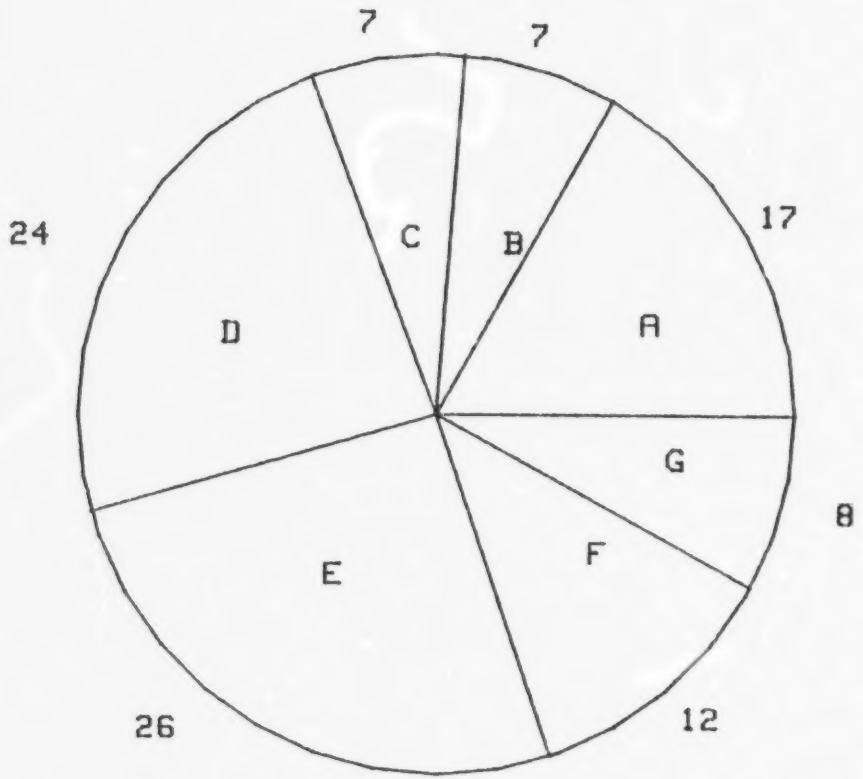
FIGURE 7.1 WIND ROSE DATA FOR 1986.
PERCENT FREQUENCY, POINT LEPREAU, N.B.



87-01-20

FIGURE 7.2 PASQUILL STABILITY CLASSES
PERCENT FREQUENCY, POINT LEPREAU, N.B. 1986.

UNITS: %
UNAVAILABLE 7%



8.0 QUALITY CONTROL AND QUALITY ASSURANCE

8.1 Introduction

Internal Quality Control checks and performance of calibrations traceable to U.S. or Canadian National Standards are routine for all analytical techniques in the Health Physics Environmental Laboratory. In addition, Quality Assurance programs regularly test the accuracy of the laboratory analytical procedures by submitting a variety of samples for blind analysis.

8.2 Quality Control

The daily Quality Control (QC) evaluations in the laboratory cover the following instruments:

1. Intrinsic Ge Gamma Spectrometer
2. Beckman LS-100C Liquid Scintillation Counter
3. Tennelec LB-5100 Gross Alpha/Beta Detector
4. Panasonic UD-710A TLD Reader

In the QC program, the operating parameters of each of the major instruments are evaluated at the start of each working day. This ensures that they are consistent from day to day and remain free from significant drift or random variation that could influence the analyses. A compilation of the statistical fluctuations is maintained day by day to show the upper and lower limits usually seen over the period of the year and from one year to the next. From these data, upper and lower flag limits are set in the QC programs. If any of the equipment exceeds any of these flag limits, then it is usually not used in any of the laboratory operations until the problem has been corrected. If, in the judgement of the laboratory supervisor, the problem will not give rise to errors in deriving data, usually because of the presence of internal standards, the equipment may still be used.

8.2.1 Intrinsic Ge Gamma Spectrometer

A daily check of seven system parameters is performed for the germanium gamma spectrometry system. The results are processed by a computer program which generates QC plots and performs statistical tests to detect out-of-range values. The program processes the results from the analysis of a Eu-152 point source which is analysed at the beginning of each working day. The parameters checked are:

1. Low energy centroid location (122 keV)
2. Low energy efficiency (122 keV)
3. Low energy resolution (122 keV)
4. High energy centroid location (1408 keV)
5. High energy efficiency (1408 keV)
6. High energy resolution (1408 keV)
7. Liquid nitrogen consumption (mass/h)

A 50000+ s background count is made weekly to ensure the absence of contamination in the sample chamber. The total counts in eight separate regions of the background spectrum are evaluated by the QC program and out-of-range values are flagged. Because of the precautions adopted in handling all samples analyzed in the laboratory, no contamination has been found to date.

Calibration

Complete efficiency calibrations on the gamma spectrometry systems are performed on an annual basis -usually at the beginning of each year- for each of the counting geometries. This is accomplished by use of an Amersham mixed nuclide standard traceable to the US National Bureau of Standards.

8.2.2 Beckman Liquid Scintillation Counter

A range of sealed tritium, carbon-14 and background standards traceable to US National Standards is analyzed daily.

8.2.3 Tennelec LB-5100 Gross Alpha/Beta Detector

Planchet standards of Am-241 and Sr-Y-90 are analyzed daily. Alpha and Beta discrimination allows the simultaneous analysis of alpha and beta emissions on all samples analyzed. Planchet and filter backgrounds are included in the QC checks.

8.2.4 Panasonic UD-710A TLD Reader

A set of 16, randomly chosen, TLDs is exposed daily on a depleted uranium slab for about 30 minutes. Readout of these TLDs monitors the Reader functions.

8.3 External Intercomparison Programs

In addition to these in-house QC checks, the Health Physics Environmental Laboratory participates in intercomparisons with other laboratories when appropriate programs are available. This allows independent verification of analytical performance. Table 8.01 lists the intercomparison programs in which NBEPC takes part.

TABLE 8.01

QUALITY ASSURANCE PROGRAMS INVOLVING OTHER AGENCIES

Sample Type	Analysis	Frequency #	Agency
Air Filters	Gross Alpha Gross beta Cs-137 Sr-90	6 months	US EPA*
Environmental Gamma rad.	TLD	Approx. every 2 years	US DOE*
Milk	Gamma	4 Months	US EPA
Fresh Water	Gross Alpha Gross beta Tritium Gamma Blind test Sr-89,90	2 months 2 months 4 months 2 months 6 months 6 months	US EPA
Food Slurry	Gamma	6 months	US EPA
Urine	Tritium	6 months	US EPA

* EPA US Environmental Protection Agency.
DOE US Department of Energy.

\# The actual frequency may vary from that indicated.

8.4 Results of Intercomparison programs

Details of performance in the laboratory intercomparisons are given in Tables 8.02 to 8.24 following. The order of the QA data is as follows:

Table 8.02	Comparison of EPA - All users and NBEPC Performance.
8.03	Laboratory Performance Evaluation.
8.04	Laboratory Performance Evaluation.
8.05	EPA Food Slurry.
8.06	EPA Food Slurry.
8.07	EPA Sr-89,90 in Water.
8.08	EPA Sr-89,90 in Water.
8.09	EPA Gamma in Water.
8.10	EPA Gamma in Water.
8.11	EPA Gamma in Water.
8.12	EPA Gamma in Milk.
8.13	EPA Gamma in Milk.
8.14	EPA Gamma in Milk.
8.15	EPA Gross Alpha in Air Filter.
8.16	EPA Iodine in Water.
8.17	EPA Sr-90 in Air Filter.
8.18	EPA Gross Beta in Air Filter.
8.19	EPA Cs-137 in Air Filter.
8.20	EPA Tritium in Water.
8.21	EPA Tritium in Urine.
8.22	EPA Gross Alpha in Water.
8.23	EPA Gross Beta in Water.
8.24	Eighth International Environmental Dosimeter Intercomparison.

Each table (except table 8.02), contains the known results given by the QA agent, the average obtained by all other participants, and the results obtained by the Health Physics Environmental Monitoring Laboratory of NBEPC. The quoted uncertainties are at the 95% confidence level unless indicated otherwise.

8.5 Discussion of QA results

The QA results for 1986 show that the laboratory equipment operated satisfactorily and that the techniques were able to provide accurate information on the test samples.

Note that the units used in the reporting of the EPA QA results are in picocuries and not becquerels. One becquerel (Bq) is 27 picocuries (pCi).

Analytical times on the test samples match those used for the analysis of comparable environmental samples. "Best effort" is not attempted, as this would require allocation of more time than is either justified or available for these analyses and would mean that a true comparison between the QA analyses and the environmental sample analyses would not be valid. This sometimes results in 'less than' values which are higher than the added activity of the test radionuclide.

The criterion for acceptable performance in the EPA tests is that the participant's results shall be within the 3 standard deviations limits about the known value. However, analyses which are consistently at these limits, whether high or low, indicate that improvements should be attempted.

TABLE 8.02

COMPARISON OF EPA, ALL PARTICIPANTS, AND NBEPC.

Analysis	Table No.	Ratio of Results NBEPC/EPA	+- 2 sigma range All Participants
Cs-137	8.04	1.13	0.62 - 1.62
	8.05	1.13	0.87 - 1.40
	8.06	1.00	0.80 - 1.30
	8.09	0.95	0.73 - 1.27
	8.10	1.50	0.70 - 1.50
	8.11	1.00	0.86 - 1.18
	8.13	1.13	1.00 - 1.39
	8.14	1.03	0.95 - 1.31
	8.19	1.00	0.70 - 1.50
	8.19	1.14	0.77 - 1.41
H-3	8.20	1.12	0.85 - 1.11
	8.20	1.03	0.75 - 1.20
	8.20	0.97	0.82 - 1.09
Sr-90	8.03	0.86	0.71 - 1.29
	8.04	0.75	0.50 - 1.50
	8.07	0.67	0.67 - 1.20
	8.08	1.00	0.60 - 1.40
	8.17	0.89	0.72 - 1.17
	8.17	0.91	0.77 - 1.23
Sr-89	8.03	0.71	0.29 - 1.43
	8.04	0.70	0.40 - 1.40
	8.07	0.90	0.68 - 1.32
	8.08	0.60	0.40 - 1.40
Gross Beta	8.03	0.97	0.66 - 1.17
	8.04	0.90	0.69 - 1.16
	8.18	1.09	0.83 - 1.34
	8.18	1.08	0.83 - 1.32
	8.23	1.00	0.43 - 1.57
	8.23	1.25	0.50 - 2.00
	8.23	1.00	0.60 - 1.40
	8.23	1.00	0.72 - 1.28
	8.23	1.13	0.50 - 2.00
	8.23	1.05	0.75 - 1.35

TABLE 8.03 87-03-12

New Brunswick Electric Power Commission

Health Physics Department

Environmental Laboratory

Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma

Program: EPA LAB PERFORMANCE EVALUATIONCollection date: 86-04-20

Analysis	EPA	* All participants		NBEPC		NBEPC/EPA
ALPHA	17 +- 7	15 +- 8		16 +- 1		0.94
BETA	35 +- 7	32 +- 9		34 +- 1		0.97
Sr-89	7 +- 7	6 +- 4		5 +- 1		0.71
Sr-90	7 +- 2	7 +- 2		6 +- 0		0.86
Co-60	10 +- 7	10 +- 4		12 +- 3		1.20
Cs-134	5 +- 7	5 +- 3		6 +- 1		1.20
Cs-137	5 +- 7	6 +- 2		<10		

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.04 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA LAB PERFORMANCE EVALUATIONCollection date: 86-10-22

Analysis	EPA	* All participants	NBEPC	NBEPC/EPA
ALPHA	40 +- 7	36 +- 19	42 +- 3	1.05
BETA	51 +- 7	47 +- 12	46 +- 2	0.90
Sr-89	10 +- 7	9 +- 5	7 +- 1	0.70
Sr-90	4 +- 2	4 +- 2	3 +- 1	0.75
Co-60	24 +- 7	24 +- 4	22 +- 8	0.92
Cs-134	12 +- 7	11 +- 4	13 +- 5	1.08
Cs-137	8 +- 7	9 +- 4	9 +- 2	1.13

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.05 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/kg ± 2 sigma
Program: EPA FOOD SLURRY Collection date: 86-01-31

Analysis	EPA	* All participants	NBEPC	NBEPC/EPA
I-131	20 ± 8	21 ± 5	21 ± 6	1.05
Cs-137	15 ± 7	17 ± 4	17 ± 3	1.13
K(mg/kg)	950 ± 202	957 ± 179	1040 ± 50	1.09

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.06 87-03-12

New Brunswick Electric Power Commission

Health Physics Department

Environmental Laboratory

Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/kg +- 2 sigma

Program: EPA FOOD SLURRY Collection date: 86-07-25

Analysis	EPA	* All participants		NBEPC		NBEPC/EPA
I-131	30 +- 8	28 +- 6		28 +- 1		0.93
Cs-137	20 +- 7	21 +- 5		20 +- 0		1.00
K(mg/kg)	1150 +- 82	1151 +- 208		1210 +- 40		1.05

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.07 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA Sr-89,90 IN WATER Collection date: 86-01-10

Analysis	EPA	* All participants	NBEPC	NBEPC/EPA
Sr-89	31 +- 7	31 +- 10	28 +- 2	0.90
Sr-90	15 +- 2	14 +- 4	10 +- 0	0.67

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.08 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA Sr-89,90 IN WATER Collection date: 86-05-09

Analysis	EPA	* All participants			NBEPC		NBEPC/EPA
Sr-89	5 +-	7	5 +-	3	3 +-	1	0.60
Sr-90	5 +-	2	5 +-	2	5 +-	1	1.00

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.09 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA
Program: EPA GAMMA IN WATER

Reporting units: pCi/L +- 2 sigma
Collection date: 86-02-07

Analysis	EPA	* All participants	NBEPC	NBEPC/EPA
Cr-51	38 +- 7	39 +- 12	<90	
Co-60	18 +- 7	18 +- 5	19 +- 3	1.06
Zn-65	40 +- 7	41 +- 7	38 +- 12	0.95
Ru-106	NA	15 +- 38	<50	
Cs-134	30 +- 7	28 +- 7	24 +- 5	0.80
Cs-137	22 +- 7	22 +- 6	21 +- 9	0.95

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.10 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA GAMMA IN WATER Collection date: 86-06-06

Analysis	EPA	* All participants	NBEPC	NBEPC/EPA
Cr-51	NA	15 +- 18	<60	
Co-60	66 +- 7	64 +- 8	58 +- 4	0.88
Zn-65	86 +- 7	86 +- 11	90 +- 14	1.05
Ru-106	50 +- 7	50 +- 22	<90	
Cs-134	49 +- 7	46 +- 8	43 +- 5	0.88
Cs-137	10 +- 7	11 +- 4	15 +- 5	1.50

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.11 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L ± 2 sigma
Program: EPA GAMMA IN WATER Collection date: 86-10-10

Analysis	EPA	* All participants	NBEPC	NBEPC/EPA
Cr-51	59 ± 7	56 ± 19	82 ± 25	1.39
Co-60	31 ± 7	31 ± 5	30 ± 6	0.97
Zn-65	85 ± 7	85 ± 14	86 ± 6	1.01
Ru-106	74 ± 7	68 ± 16	78 ± 19	1.05
Cs-134	28 ± 7	26 ± 5	27 ± 6	0.96
Cs-137	44 ± 7	45 ± 7	44 ± 7	1.00

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.12 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA GAMMA IN MILK Collection date: 86-02-28

Analysis	EPA	* All participants		NBEPC		NBEPC/EPA
I-131	9 +- 8	9 +- 3		9 +- 0		1.00

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.13 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA
Program: EPA GAMMA IN MILK

Reporting units: pCi/L +- 2 sigma
Collection date: 86-06-27

Analysis	EPA	* All participants	NBEPC	NBEPC/EPA
I-131	41 +- 8	44 +- 9	44 +- 1	1.07
Cs-137	31 +- 7	37 +- 6	35 +- 2	1.13
K(mg/L)	1600 +- 113	1601 +- 221	1660 +- 80	1.04

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.14 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA GAMMA IN MILK Collection date: 86-10-31

Analysis	EPA	* All participants	NBEPC	NBEPC/EPA
I-131	49 +- 8	49 +- 9	45 +- 4	0.92
Cs-137	39 +- 7	44 +- 7	40 +- 5	1.03
K(mg/L)	1565 +- 110	1565 +- 212	1520 +- 140	0.97

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.15 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi +- 2 sigma
Program: EPA GROSS ALPHA IN AIR FILTER

Collection date	EPA	* All participants		NBEPC		NBEPC/EPA
86-04-25	15 +-	7	16 +- 6	15 +-	3	1.00
86-09-12	22 +-	7	22 +- 9	23 +-	3	1.05

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.16 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA
Program: EPA IODINE IN WATER

Reporting units: pCi/L ± 2 sigma

Collection date	EPA	* All participants		NBEPC		NBEPC/EPA
86-04-04	9 ± 8	9 ± 4		8 ± 2		0.89
86-08-08	45 ± 8	42 ± 12		38 ± 2		0.84

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.17 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi +- 2 sigma
Program: EPA Sr-90 IN AIR FILTER

Collection date	EPA	* All participants		NBEPC		NBEPC/EPA
86-04-25	18 +- 2	17 +- 4		16 +- 1		0.89
86-09-12	22 +- 2	22 +- 5		20 +- 3		0.91

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.18 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi +- 2 sigma
Program: EPA GROSS BETA IN AIR FILTER

Collection date	EPA	* All participants		NBEPC		NBEPC/EPA
86-04-25	47 +- 7	51 +- 12		51 +- 5		1.09
86-09-12	66 +- 7	71 +- 16		71 +- 9		1.08

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.19 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi +- 2 sigma
Program: EPA Cs-137 IN AIR FILTER

Collection date	EPA	* All participants		NBEPC		NBEPC/EPA
86-04-25	10 +- 7	11 +- 4		10 +- 1		1.00
86-09-12	22 +- 7	24 +- 7		25 +- 7		1.14

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.20 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA TRITIUM IN WATER

Collection date	EPA	* All participants	NBEPC	NBEPC/EPA
86-02-14	5227 +- 740	5105 +- 680	5880 +- 470	1.12
86-06-13	3125 +- 509	3052 +- 694	3210 +- 700	1.03
86-10-17	5973 +- 844	5694 +- 812	5770 +- 930	0.97

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.21 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA TRITIUM IN URINE

Collection date	EPA	* All participants	NBEPC	NBEPC/EPA
86-04-25	4423 +- 625	4412 +- 505	4730 +- 750	1.07
86-11-07	5257 +- 744	5158 +- 573	5260 +- 980	1.00

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.22 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA GROSS ALPHA IN WATER

Collection date	EPA	* All participants		NBEPC		NBEPC/EPA
86-01-24	3 +- 7	4 +- 3		4 +- 1		1.33
86-03-21	15 +- 7	13 +- 7		16 +- 3		1.07
86-05-23	8 +- 7	7 +- 4		9 +- 0		1.13
86-07-18	6 +- 7	6 +- 4		8 +- 2		1.33
86-09-19	15 +- 7	15 +- 8		17 +- 4		1.13
86-11-21	20 +- 7	17 +- 10		23 +- 3		1.15

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.23 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: EPA Reporting units: pCi/L +- 2 sigma
Program: EPA GROSS BETA IN WATER

Collection date	EPA	* All participants			NBEPC		NBEPC/EPA
86-01-24	7 +-	7	7 +-	4	7 +-	1	1.00
86-03-21	8 +-	7	10 +-	6	10 +-	0	1.25
86-05-23	15 +-	7	15 +-	6	15 +-	1	1.00
86-07-18	18 +-	7	18 +-	5	18 +-	1	1.00
86-09-19	8 +-	7	10 +-	6	9 +-	1	1.13
86-11-21	20 +-	7	20 +-	6	21 +-	1	1.05

NA: Results Not Available

* Excluding those results significantly different from the population mean.

TABLE 8.24 87-03-12

New Brunswick Electric Power Commission
Health Physics Department
Environmental Laboratory
Quality Assurance Program

Intercomparison with: DOE Reporting units: mR +- 2 sigma
Program: DOSIMETER INTERCOMPARISON Collection date: 86-06-01

Analysis	DOE	* All participants		NBEPC		NBEPC/DOE
Field 1	30 +- 3	29 +- 12		29 +- 3		0.98
Field 2	10 +- 1	10 +- 9		8 +- 3		0.76
Cs-137	17 +- 2	16 +- 7		20 +- 3		1.14

NA: Results Not Available

* Excluding those results significantly different from the population mean.

APPENDIX 1.

CHERNOBYL FALLOUT IN NEW BRUNSWICK.

These data were collected in New Brunswick after the April 26 (1986) nuclear reactor accident at Chernobyl in the USSR. Most of the results are reported within the body of the Environmental Monitoring Program, but some data, collected outside of the program, or on samples submitted by external agencies, are incorporated into this section.

All data were distributed to the Dept. of Health and Welfare (RPB) in Ottawa and to the New Brunswick Dept. of Health as they were collected and evaluated. Locally grown produce, (rhubarb and fiddleheads), which began to appear on market shelves at this time as well as imported vegetables, i.e., red lettuce from Italy and anise from Holland, were analyzed as the samples became available.
The Health Protection Branch, of Health and Welfare Canada, Saint John, provided samples of rainwater from various locations in the south of the province. The NB Dept of Health supplied samples of locally purchased cheeses and meat and the NB Dept of Natural Resources provided a sample of venison from a road killed deer.
The data are tabulated in chronological sequence where possible, and list the fission product radionuclides detected with their concentrations. Where significant concentrations of naturally occurring radionuclides are present, e.g., Be-7 and K-40, these are also listed, both to provide perspective and to show consistency with earlier data on samples containing these natural radionuclides

The established Environmental Monitoring program of the NBEPC was not interrupted or changed for this coverage. However, a temporary air monitoring station was established in Fredericton and supplementary samples were collected, usually on a daily basis, for analysis. The intent was to monitor daily fluctuations as far as possible and to show when radionuclides first became detectable or disappeared from environmental samples. Samples of fresh milk were supplied by the local milk collection and marketing agency for prompt analysis on a regular basis to monitor cesium-137 and iodine-131 concentrations in milk before, and as, cows started to go to pasture.

The data showed that radionuclide levels in foods and water in this province from Chernobyl, were relatively trivial. The activity levels that were detected were a small fraction of the natural radionuclide activities present in all foods.

DATA COLLECTED IN NEW BRUNSWICK FROM THE CHERNOBYL ACCIDENT OF APRIL 26, 1986.

TABLE 1

Airborne Radionuclides Detected (Bq/m^3)
Fredericton, New Brunswick, Air Monitoring Station.

	I-131	Cs-134	Cs-137	Ru-103	La-140	Te-132	I-132*
May							
7	<8E-3	<9E-3	<1E-2	<5E-3	<2E-2	nd	nd
7-8	2.6E-3	<8E-4	<1E-3	<1E-3	<1E-3	nd	nd
8-9	8.3E-3	<8E-4	1.6E-3	<8E-4	<5E-4	nd	nd
9-12	2.9E-2	3.7E-3	7.3E-3	1.1E-3	8.1E-4	1.4E-3	1.0E-3
12-13	1.0E-2	1.0E-3	3.1E-3	<8E-4	<5E-4	nd	nd
13-14	1.7E-2	3.7E-3	6.4E-3	2.3E-3	<2E-3	nd	nd
14-16	1.6E-2	2.0E-3	3.7E-3	2.9E-3	<2E-3	nd	nd
16-17	8.2E-3	2.0E-3	3.4E-3	2.5E-3	<2E-3	nd	nd
17-19	3.3E-3	6.5E-4	7.7E-4	8.1E-4	<7E-4	nd	nd
19-20	2.1E-3	<2E-3	<9E-4	<2E-3	<2E-3	nd	nd
20-22	6.6E-4	<4E-4	<4E-4	<4E-4	<3E-4	nd	nd
22-26	2.6E-3	4.0E-4	9.3E-4	1.1E-3	<2E-4	nd	nd
26-29	2.3E-3	5.8E-4	1.2E-3	1.4E-3	<6E-4	nd	nd
May-June							
29-03	2.2E-3	5.7E-4	1.3E-3	2.6E-3	<4E-4	nd	nd
03-05	1.2E-3	<1E-3	2.3E-3	2.7E-3	<2E-3	nd	nd

nd is not detected, the 'less than' value is about 4E-4 Bq/m^3.

Air Monitoring was terminated at this temporary location on June the 5th.

TABLE 2

Airborne Radio-nuclides Detected (Bq/m³).
Southern New Brunswick, PLGS Air Monitoring Stations.

Locn. Data averaged over the interval May 7th to May 14th.

	I-131	Cs-134	Cs-137	Ru-103	Te-132	I-132*	Sr-90
A01R	1.8E-2	1.4E-3	3.1E-3	7.2E-4	4.8E-4	7.2E-4	<3.6E-5
E01	1.5E-2	1.4E-3	2.7E-3	4.8E-4	4.6E-4	4.3E-4	<3.5E-5
F01	1.7E-2	1.6E-3	3.2E-3	6.4E-4	6.5E-4	4.3E-4	<5.1E-5
G02	1.8E-2	1.5E-3	2.7E-3	7.9E-4	7.4E-4	6.3E-4	<5.5E-5
H04	1.7E-2	1.4E-3	2.8E-3	6.1E-4	6.6E-4	7.1E-4	<6.3E-5
I01	1.9E-2	1.4E-3	3.1E-3	7.9E-4	8.3E-4	nd	4.9E-5
K02	1.8E-2	1.7E-3	3.0E-3	7.0E-4	6.4E-4	6.1E-4	<3.4E-5
N01	1.7E-2	1.7E-3	3.4E-3	5.9E-4	6.9E-4	7.6E-4	<4.8E-5

Locn. Data averaged over the interval of May 14th to May 26th.

	I-131	Cs-134	Cs-137	Ru-103	Te-132	I-132*
A01R	2.9E-3	5.7E-4	1.3E-3	<9.3E-4	nd	nd
E01	2.7E-3	5.6E-4	1.4E-3	8.1E-4	nd	nd
F01	2.5E-3	5.1E-4	1.2E-3	8.2E-4	nd	nd
G02	2.5E-3	5.2E-4	1.3E-3	7.1E-4	nd	nd
H04	2.4E-3	5.1E-4	1.3E-3	7.4E-4	nd	nd
I01 (1)	2.7E-3	5.4E-4	1.3E-3	7.4E-4	nd	nd
K02	2.4E-3	6.3E-4	1.4E-3	7.8E-4	nd	nd
N01	2.5E-3	5.8E-4	1.1E-3	7.2E-4	nd	nd

(1) La-140 1.5E-04 Bq/m³

Locn. Data averaged over the interval from May 26th to June 11th

	I-131	Cs-134	Cs-137	Ru-103	Te-132	I-132*
A01R	1.0E-3	3.5E-4	8.7E-4	1.6E-3	nd	nd
E01	9.4E-4	4.4E-4	9.2E-4	1.4E-3	nd	nd
F01	9.0E-4	3.7E-4	8.8E-4	1.4E-3	nd	nd
G02	4.9E-4	2.0E-4	3.3E-4	7.0E-4	nd	nd
H04	8.5E-4	4.4E-4	1.0E-3	1.5E-3	nd	nd
I01	8.7E-4	5.2E-4	1.1E-3	1.5E-3	nd	nd
K02	6.4E-4	4.0E-4	1.0E-3	1.6E-3	nd	nd
N01	8.2E-4	2.9E-4	7.8E-4	1.3E-3	nd	nd

TABLE 2 (Contd.)

Locn.	Data averaged over the interval from June 11th to 24th					
	I-131	Cs-134	Cs-137	Ru-103	Te-132	I-132*
A01R	<1.4E-4	<7.1E-5	<1.5E-4	1.8E-4	nd	nd
E01	<7.3E-5	<3.7E-5	7.3E-5	<1.0E-4	nd	nd
F01	<1.4E-4	<8.7E-5	<1.3E-4	<1.5E-4	nd	nd
G02	<9.6E-5	<6.4E-5	<5.7E-5	<1.2E-4	nd	nd
H04	<1.4E-4	<1.2E-4	<1.2E-4	2.2E-4	nd	nd
I01	<1.7E-4	<7.2E-5	1.6E-4	2.3E-4	nd	nd
K02	<9.4E-5	<6.9E-5	<7.3E-5	1.4E-4	nd	nd
N01	<9.4E-5	<4.0E-5	<5.9E-5	<1.0E-4	nd	nd

Air particulate and air iodine samples from all of the air monitoring locations which were sampled from June 24th onwards, did not contain detectable quantities of any of the above radionuclides.

* Short lived daughter of Te-132.

TABLE 3

Radionuclides in New Brunswick Dairy Herd Milk (Bq/L)*

Collection Dates. (1)	Milk Type.	I-131	Cs-134	Cs-137 #
May 8th to May 11th	Dairy, skim.	<2E-1	<1E-1	<1E-1
May 11th to May 12th	Dairy, homo.	<2E-1	<1E-1	<1E-1
May 12th to May 14th	DPC, whole milk.	6E-1	<4E-2	<1E-1
May 13th to May 15th	DPC, whole milk.	5E-1	<4E-2	7E-2
May 17th to May 19th	DPC, whole milk.	1E+0	<8E-2	1E-1
May 19th to May 21st	DPC, whole milk.	6E-1	<5E-2	<1E-1
May 19th to May 21st	Herd, on grass.	6E-1	<9E-2	2E-1
May 21st to May 23rd	Dairy, homo.	2E-1	<9E-2	<1E-1
May 23rd to May 25th	DPC, whole milk.	6E-1	1E-1	2E-1
May 24th to May 26th	DPC, whole milk.	5E-1	1E-1	3E-1
June 3rd to June 6th	Dairy, homo.	4E-1	2E-1	5E-1
July 1st	Dairy, homo.	<6E-2	9E-2	3E-1
July 17th	Herd, on grass	<7E-2	7E-2	2E-1
Aug. 4th	Dairy, homo.	<6E-2	7E-2	2E-1
Sept. 1st	Dairy, homo	<6E-2	<4E-2	<1E-1
Sept. 25th	Herd, on grass	<9E-2	<4E-2	1E-1
Oct. 2nd	Dairy, homo	<9E-2	<7E-2	2E-1
Nov. 13th	Herd, on grass?	<6E-2	<9E-2	1E-1
Nov. 14th	Dairy, homo	<7E-2	<5E-2	1E-1
Dec. 5th	Dairy, homo	<6E-2	<9E-2	2E-1

* All milks contain naturally occurring radionuclides. These include uranium, thorium and their decay daughters, as well as K-40 at a level of between 45 and 55 Bq/L. Cesium-137 and Strontium-90 occur in milk because of atmospheric bomb testing in the late 50's through to as late as 1980, with some contribution now visible from the Chernobyl accident.

(1) Few cows in New Brunswick are out on pasture before the end of May.

The level of Cs-137 seen in samples up to May the 23rd, is comparable with that seen previously in milk and originates in fallout from bomb tests. Data from 1985, show that cesium-137 was detected in about half of the milks analysed, at concentrations from 8E-2 to 2E-1 Bq/L. Some elevation in activity levels in milk due to the accident at Chernobyl is obvious after the May 23rd sample, but with a return to about the 1985 levels after only two or three months.

DPC is the Dairy Products Commission.
Dairy, means milk from a commercial dairy, purchased at a local store.
Herd, means milk from an individual farm herd.

TABLE 4

Meat and Dairy Products (Bq/kg).

Fredericton (86-05-24)	I-131	Cs-137	K-40
Ground beef	<1E+0	<4E-1	5.4E+1
Cottage cheese	<2E-1	<2E-1	2.3E+1
Mild cheddar cheese	<5E-1	<7E-1	2.3E+1
Venison (2yr buck, June 16)	<1E+0	5.1E+1	1.3E+2

TABLE 5

Miscellaneous Samples of Vegetation, Rainwater, Sediments Well Waters and other samples. (Bq/kg or Bq/L).

		I-131	Cs-134	Cs-137	K-40	Be-7
Lichen from N.B.(Bq/kg)						
Date in 1986.			Before Chernobyl			
Jan	Tree Lichen	<8E+0	<5E+0	4.2E+1	1.9E+2	1.9E+2
Apr	Tree Lichen	<6E+0	<4E+0	3.5E+1	1.2E+2	1.9E+2
Apr	Tree Lichen	<1E+1	<6E+0	1.9E+1	<2.1E+2	4.4E+2
Apr	Tree Lichen	<2E+1	<9E+0	4.6E+1	<3.7E+2	3.5E+2
Apr	Tree Lichen	<1E+1	<8E+0	3.7E+1	<2.5E+2	3.4E+2
			After Chernobyl			
May 11	Tree Lichen	1.7E+1	<4E+0	3.6E+1	<1.0E+2	2.7E+2
May 11	Lycopodium	2.2E+1	<3E+0	3.6E+1	1.7E+2	4.5E+1
May 11	Ground moss	1.8E+1	<6E+0	2.0E+2	3.0E+2	1.5E+2
May 19	Tree Lichen	3.3E+2	6E+0	5.5E+1	1.5E+2	3.2E+2
May 19	Lycopodium	2.1E+1	<4E+0	5.4E+1	2.2E+2	1.0E+2
May 19	Ground moss	1.6E+1	<8E+0	3.2E+2	2.5E+2	2.1E+2
May 19	Old Cladonia	2.0E+1	<5E+0	1.7E+2	1.4E+2	2.3E+2
May 19	New Cladonia	5.2E+1	<5E+0	7.6E+1	<1.6E+2	2.7E+2
May 19	Lycopodium *	8E+0	<4E+0	8E+0	7.8E+1	<2.8E+1
May 27	Tree Lichen	1.3E+2	<2E+1	8.1E+1	1.2E+2	3.4E+2
May 27	Ground Moss	1.5E+1	<9E+0	1.5E+2	2.1E+2	2.6E+2
Jul 12	Tree Lichen	<1.0E+1	1.7E+1	6.6E+1	1.4E+2	3.1E+2
Sept 25	Tree Lichen	<4E+0	1.0E+1	4.2E+1	9.5E+1	2.1E+2
Oct 13	Tree Lichen	<7E+0	1.0E+1	3.0E+1	1.8E+2	3.3E+2
Oct 22	Tree Lichen	<5E+0	2.1E+1	6.3E+1	9.0E+1	4.3E+2
Oct 22	Tree Lichen	<9E+0	1.9E+1	6.8E+1	<3.0E+2	2.0E+2
Oct 22	Tree Lichen	<2E+1	1.9E+1	5.8E+1	2.4E+2	3.8E+2
Nov 13	Tree Lichen	<7E+0	1.3E+1	5.4E+1	1.4E+2	1.5E+2

* non trailing variety of Lycopodium.

TABLE 5(Cont)

Other Vegetation.

	I-131	Cs-134	Cs-137	K-40	Be-7
May 19 Ostrich Fern.	<1.3E+1	<5E+0	3.3E+1	1.7E+2	<4.0E+1
May 20 Fiddleheads	<3E+0	<1E+0	<3E+0	1.1E+2	nd
May 21 Fiddleheads	<1E+0	<1E+0	<2E+0	1.6E+2	nd
May 21 Rhubarb	<3E+0	<2E+0	<3E+0	9.5E+1	nd
May 21 Rhubarb	<5E+0	<2E+0	<4E+0	9.0E+1	nd
Aug 13 Blueberries	<6E-1	<6E-1	2E+0	2.4E+1	<6E+0

IMPORTED PRODUCE.

	I-131	Cs-134	Cs-137	K-40	Be-7
Red Lettuce (Italy)	<1.1E+1	6E+0	1.8E+1	1.2E+2	<1.6E+1
Anise (Holland)	<3E+0	<1E+0	<1E+0	2.2E+2	<4E+0

Rainwater (Bq/L). N.B.	I-131	Be-7
May 13 Hampton	<2E+0	nd
May 16 Blacks Harbour	<1E+0	nd
May 17 Fredericton	2E+0	6E+0
May 26 Rock light *	<2E+0	
May 26 Seal light *	<2E+0	

* semi-quantitative 5000s analysis on a sodium-iodide detector.

TABLE 6

Fine Grained Beach Sediment, Point Lepreau area.

(collected on May 14th, (Bq/kg).

	Cs-137	Be-7	Ru-103
D04 location, Point Lepreau.	3E+0	2.0E+1	<9E-1
D01 location, Point Lepreau.	3E+0	3.3E+1	<1E+0
Beach sediments collected on June 27th, Point Lepreau area.			
D04	2E+0	1.7E+1	<2E+0
D01	7E+0	4.9E+1	3E+0
C01	3E+0	2.0E+1	<3E+0
Q01R	2E+0	1.9E+1	<2E+0
N04	3E+0	3.3E+1	<2E+0
Beach sediments collected on August 27th, Point Lepreau area.			
D04	5E+0	9.9E+1	<1E+0
D01	<4E+0	7.1E+1	<1E+0
C01	3E+0	3.9E+1	<1E+0
Q01R	<3E+0	3.8E+1	<1E+0
N04	<2E+0	1.9E+1	<1E+0